BROOKHAVEN NATIONAL LABORATORY

Work Permit # SS-2010-189 [DRL-2010-14]
Work Order # _____
Job# _____ Activity# _____

1. Work requester fills out this section. ☐ **Standing Work Permit**

Requester: Don Lynch	Date: 06/29/2010	Ext.: 2253	Dept/Div/Group: PO/PHENIX
Other Contact person (if different from requester): Carter Biggs			Ext.: 7515
Work Control Coordinator: Don Lynch		Start Date: 07/19/2010	Est. End Date: 9/30/2010
Brief Description of Work: Replace and Upgrade PHENIX Beampipe			
Building: 1008	Room: IR & AH	Equipment: PHENIX Beampipe components	Service Provider: PHENIX techs & CAD Vacuum techs

. WCC, Requester/Designee, Service Provider, and ES&H (as necessary) fill out this section or attach analysis

ES&H ANALYSIS				
Radiation Concerns	☐ None	☒ Activation	☐ Airborne	☐ Contamination	☒ Radiation
Radiation Generating Devices:	☐ Radiography	☐ Moisture Density Gauges	☐ Soil Density Gauges	☐ X-ray Equipment
☐ Special nuclear materials involved, notify Isotope Special Materials Group			☐ Fissionable materials involved, notify Laboratory Criticality Officer	
Safety Concerns	☐ None	☐ Ergonomics	☐ Transport of Haz/Rad Material	
☐ Adding/Removing Walls or Roofs	☐ Confined Space*	☐ Explosives	☐ Lead*	☐ Penetrating Fire Walls
	☐ Corrosive	☐ Flammable	☐ Magnetic Field*	☐ Pressurized Systems
☐ Asbestos*	☐ Cryogenic	☐ Fumes/Mist/Dust*	☐ Material Handling	☐ Rigging/Critical Lift
☒ Beryllium*	☐ Electrical	☐ Heat/Cold Stress	☐ Noise*	☐ Toxic Materials*
☐ Biohazard*	☒ Elevated Work*	☐ Hydraulic	☐ Non-ionizing Radiation*	☒ Vacuum
☐ Chemicals*	☐ Excavation	☐ Lasers*	☐ Oxygen Deficiency*	☐ Other
* Does this work require medical clearance or surveillance from the Occupational Medicine Clinic? ☐ Yes ☒ No				
Environmental Concerns		☒ None	☐ Work impacts Environmental Permit No.	
☐ Atmospheric Discharges (rad/non-rad)		☐ Land Use	☐ Soil Activation/contamination	☐ Waste-Mixed
☐ Chemical or Rad Material Storage or Use		☐ Liquid Discharges	☐ Waste-Clean	☐ Waste-Radioactive
☐ Cesspools (UIC)		☐ Oil/PCB Management	☐ Waste-Hazardous	☐ Waste-Regulated Medical
☐ High water/power consumption		☐ Spill potential	☐ Waste-Industrial	☐ Underground Duct/Piping
Waste disposition by:				☐ Other
Pollution Prevention (P2)/Waste Minimization Opportunity:		☒ None ☐ Yes		
FACILITY CONCERNS	☒ None			
☐ Access/Egress Limitations	☐ Electrical Noise	☐ Potential to Cause a False Alarm		☐ Vibrations
	☐ Impacts Facility Use Agreement		☐ Temperature Change	☐ Other
☐ Configuration Control	☐ Maintenance Work on Ventilation Systems		☐ Utility Interruptions	
WORK CONTROLS				
Work Practices				
☐ None	☐ Exhaust Ventilation	☒ Lockout/Tagout	☐ Spill Containment	☐ Security (see Instruction Sheet)
☒ Back-up Person/Watch	☐ HP Coverage	☐ Posting/Warning Signs	☐ Time Limitation	☐ Other
☐ Barricades	☐ IH Survey	☐ Scaffolding-requires inspection	☐ Warning Alarm (i.e. "high level")	
Protective Equipment				
☐ None	☐ Ear Plugs	☐ Gloves	☐ Lab Coat	☒ Safety Glasses
☐ Coveralls	☐ Ear Muffs	☐ Goggles	☐ Respirator	☒ Safety Harness
☐ Disposable Clothing	☐ Face Shield	☒ Hard Hat	☐ Shoe Covers	☒ Safety Shoes ☐ Other
Permits Required (Permits must be valid when job is scheduled.)				
☒ None	☐ Cutting/Welding	☐ Impair Fire Protection Systems		
☐ Concrete/Masonry Penetration	☐ Digging/Core Drilling	☐ Rad Work Permit-RWP No		
☐ Confined Space Entry	☐ Electrical Working Hot	☐ Other		
Dosimetry/Monitoring				
☐ None	☐ Heat Stress Monitor	☐ Real Time Monitor	☒ TLD (when in tunnel only)	
☐ Air Effluent	☐ Noise Survey/Dosimeter	☐ Self-reading Pencil Dosimeter	☐ Waste Characterization	
☐ Ground Water	☐ O_2/Combustible Gas	☐ Self-reading Digital Dosimeter	☐ Other Check O2 level prior to entry	
☐ Liquid Effluent	☐ Passive Vapor Monitor	☐ Sorbent Tube/Filter Pump		
Training Requirements (List below specific training requirements)				
Confined Space, CA –Collider User, PHENIX Awareness, Working at heights, Be Awareness				
Based on analysis above, the Walkdown Team determines the risk, complexity, and coordination ratings below:			**If using the permit when all hazard ratings are low, only the following need to sign: (Although allowed, there is no need to use back of form)**	
ES&H Risk Level:	☐ Low ☒ Moderate ☐ High		WCC:	Date:
Complexity Level:	☐ Low ☒ Moderate ☐ High		Service Provider:	Date:
Work Coordination:	☐ Low ☒ Moderate ☐ High		Authorization to start	Date:
			(Departmental Sup/WCC/Designee)	

3. Both work requester and service provider contribute to work plan (use attachments for detailed plans)

Work Plan (procedures, timing, equipment, and personnel availability need to be addressed): This project has been reviewed with CAD Vacuum engineers and a detailed plan has been written (see attached). All technicians involved in the work permitted herein shall take the BNL Be Awareness course as a refresher and review the attached "BURF".
Special Working Conditions Required: None
Operational Limits Imposed: .
Post Work Testing Required: No

Job Safety Analysis Required: ☐ Yes ☒ No	Walkdown Required: ☒ Yes ☐ No

Reviewed by: Primary Reviewer will determine the size of the review team and the other signatures required based on hazards and job complexity. Primary Reviewer signature means that the hazards and risks that could impact ES&H have been identified and will be controlled according to BNL requirements.

Title	Name (print)	Signature	Life #	Date
Primary Reviewer				
ES&H Professional				
Other				
Other				
Work Control Coordinator				
Service Provider				
	Review Done: ☐ in series	☐ team		

4. Job site personnel fill out this section.

Note: Signature indicates personnel performing work have read and understand the hazards and permit requirements (including any attachments).			
Job Supervisor:		Contractor Supervisor:	
Workers:	Life#:	Workers :	Life#:
Workers are encouraged to provide feedback on ES&H concerns or on ideas for improved job work flow. Use feedback form or space below.			

5. Departmental Job Supervisor, Work Control Coordinator/Designee

Conditions are appropriate to start work: (Permit has been reviewed, work controls are in place and site is ready for job.)			
Name:	Signature:	Life#:	Date:

6. Departmental Job Supervisor, Work Requester/Designee determines if Post Job Review is required. ☐ Yes ☐ No

Post Job Review (Fill in names of reviewers)			
Name:	Signature:	Life#:	Date:
Name:	Signature:	Life#:	Date:

7. Worker provides feedback.

Worker Feedback (use attached sheets as necessary)
a) WCM/WCC: Is any feedback required? ☐ Yes ☐ No

b) Workers: Are there better methods or safer ways to perform this job in the future? ☐ Yes ☐ No

8. Closeout: Work Control Coordinator (authorizing dept.) checks quality of completed permit and ensures the work site is left in an acceptable condition. (WCC can delegate clean up of work area to work supervisor)

Name:	Signature:	Life#:	Date:
Comments:			

Attachment to W.P. # SS2010-217 [DRL-2010-14]
June 29, 2010,

Upgrade of the PHENIX Beampipe

Introduction

In the 2010 shutdown, the PHENIX experiment plans to upgrade its existing Beampipe components to NEG coated components. The existing central Beryllium and Stainless Steel beampipe component (3.0" OD) is being replaced with 3 components: a central Beryllium, aluminum and stainless steel section with a 1.575 ID and 2 transition components to transition from the smaller new central beampipe to 3.0" OD as on the current beampipe. The 2 existing 3 inch to 5 inch OD transition and the 5 inch spool component south of the south 3 to 5 inch transition will be replaced with geometrically identical but internally NEG coated components.

Work Plan

This work is to be done by fully trained and experienced personnel (PHENIX and CAD mechanical and vacuum technicians during the 2010 summer shutdown.

(Please see the attached Beampipe Installation Plan which accompanies this Work Permit for illustrated descriptions of each of the following steps.)

The work described herein is to be performed by PHENIX technicians unless otherwise indicated. Much of the work described herein will be performed at beam height which will require the use of manlifts and/or ladders to accomplish these tasks. Technicians performing these tasks shall be trained for working at heights, working with portable ladders and shall wear the appropriate fall protection. In addition, some of the work requires the use of the PHENIX cranes; all PHENIX technicians using cranes shall have appropriate training the specific cranes utilized and rigging training. Technicians working in the square MuID steel hole shall wear a TLD radiation badge and shall have had confined space training. The MuID square hole shall be considered a class 1 confined space.

A. Preparation

1. At the start of the 2010 shutdown, PHENIX technicians wiil perform the customary tasks associated with the start of a shutdown every year. These include prepping and moving the East Carriage to the Assembly Hall, removing and storing the MuID collars, and installing manlifts, 12 ton cart and floor plates for sturdy working surfaces. As part of the process CAD vacuum Techs routinely close the niorth and south vacuum gate vales. *Make sure that CAD vacuum techs have closed the north and south gate valves, isolating the PHENIX beampipe component, and*

make sure CAD vacuum engineering is aware that the valves need to remain closed until the new beampipe installation is complete.

2. Remove the HBD east and west detectors (A Separate work permit, DRL-2010-9, has been written for this). This detector will then be retired.

3. Remove the RXNP north and south detectors (A Separate work permit, DRL-2010-10, has been written for this). This detector will then be retired.

4. Remove the BBC north and south detectors (A Separate work permit, DRL-2010-7, has been written for this). This detector will be reinstalled after the new Beampipe has been installed, baked and aligned.

5. Remove the MPC north and south detectors (A Separate work permit, DRL-2010-8, has been written for this). This detector will be reinstalled after the new Beampipe has been installed, baked and aligned.

6. Remove cabling, piping cable management feature, electronics and racks pertaining to the HBD and RXNP detectors.

7. Remove MMS east vertical lampshade (required to support other shutdown activities. CAD techs perform this task.)

B. Old Beampipe De-Installation Procedure.

1. Break Vacuum at Bellows between CM and MMS and between MMS and MuID. (CAD vacuum techs perform this task) Remove the south bellows and place it in a Nitrogen filled bag until needed later with the new beampipe installation.

2. Field assemble temporary supports for south end of Be/SS pipe using unistrut and/or other standard hardware.

3. Move the MMS north.

4. Disassemble the south 5 inch spool at both ends and remove it to the AH for safekeeping. Fill the spool with dry N2 gas and cap both ends.

5. Pull the south 3-5 transition south out of the MMS and then remove it to the AH for safekeeping. Fill the spool with dry N2 gas and cap both ends.

6. Provide field assembled support for the central Be/SS pipe in the central section of the CM.

7. Move the MMS south then move the CM south.

8. Disconnect the north Bellows. Remove the north bellows and place it in a Nitrogen filled bag until needed later with the new beampipe installation.

9. Field assemble temporary supports for north end of Be/SS pipe using unistrut and/or other standard hardware.

10. Move the CM north then slide the central BE/SS beampipe into the MMS. Field assemble temporary supports for north end of Be/SS pipe on the north side of t5he MMS using unistrut and/or other standard hardware.
11. Move CM north. Move the MMS north until the roller supports are aligned with the east-west tracks. Field assemble temporary supports for the south end of Be/SS pipe using unistrut and/or other standard hardware on the south side of the MMS.

12. Prep the MMS for moving to the assembly hall by disconnecting all cabling and piping to the MMS.

13. Jack up the east side of the MMS and rotate the roller supports 90 degrees to align with the east-west tracks then lower the jack to restore support from the rollers. Do the same for the west side. Move the MMS south in the IR until the central Be/SS beampipe riding inside the MMS can be easily removed.

14. Pull the central Be/SS beampipe north out of the MMS and then remove it to the AH for safekeeping. Fill the beampipe with dry N2 gas and cap both ends.

15. Move the MMS further south into the AH.

16. Prep the CM for moving eastward by disconnecting all cables and piping from underneath.

17. Move the CM south until the roller supports align with the east-west tracks. Jack up the east side of the CM and rotate the roller supports 90 degrees to align with the east-west tracks then lower the jack to restore support from the rollers. Do the same for the west side.

18. Move the CM east in the IR until the east rollers are near the sill. to allow.

19. Disconnect north 3-5 transition from inside north square hole. Remove the beampipe and its suppporting equipment (rollers, bakeout blanket, etc.). by pulling it south out of the MMN and into the area vacated by the CM. Remove it to the AH for safekeeping. Fill the beampipe with dry N2 gas and cap both ends.

20. Contact CAD vacuum group to take possession of all beampipe components removed in the steps above (except for the north and south bellows). The CAD vacuum group shall maintain these components as emergency spares for the future.

Note: during this and the subsequent installation of the new beampipe, there will be several times when temporary support of the various beampipe sections will be required. These supports shall be fabricated by PHENIX technicians from unistrut and soft cushioning material to provide positive support and protection for the relevant beampipe components while they are being positioned for assembly and alignment. This is a worker planned work effort to be accomplished by the PHENIX techs in coordination with the PHENIX work control coordinator and PHENIX engineering.

C. Opportunity for Other PHENIX Detector Subsystem Maintenance, Troubleshooting, Repair and Upgrade Tasks

At this point in the installation process, the existing current beampipe has been completely removed and the PHENIX large magnets and carriages are positioned to begin installation of the beampipe upgrade. This is a very convenient configuration, however, to perform maintenance, repair and upgrade tasks on other PHENIX subsystems, in particular the Muon Tracker (MuTr), Muon Trigger Front End Electronics (MuTrigger FEE), Drift Chamber and Pad Chamber 1 (DC and PC1, respectively. It is also convenient to install the new RPC absorber in the "Flower Pot" regions of the CM. This is because the absence of the beampipe makes of all of these subsystems easier and safer to access using manlifts.

The work on each of these subsystems has its own work permits as follows:

MuTr and MuTrigger FEE: DRL-2010-12 (work on and in MMN) and DRL-2010-13 (work on and in MMS)

DC: DRL 2010-15

PC1: DRL-2010-22

RPC Absorber: DRL-2010-11

D. Beampipe Upgrade Installation Procedure

1. Prepare the new north 3-5 inch transition with rolling supports, bakeout heaters, bakeout thermocouples and bakeout insulation ("blankets"). The bakeout equipment shall be installed by CAD vacuum technicians.

2. Install the north 3-5" transition into the MMN and connect it to the north gate valve in the north MuID square hole.

3. Place new central area rolling BP supports in the CM. Install New Be section in CM from the north side taking care to manual support the BP at all times to prevent sudden movements, jerks or contact of any kind between the beampipe and any other

items and place the beampipe on the new CM rolling supports.

4. Move the CM west until the roller supports align with the north south tracks. Jack up the east side of the CM and rotate the roller supports 90 degrees to align with the north-south tracks then lower the jack to restore support from the rollers. Do the same for the west side. The CM should now be in alignment with the beamline axis.

5. Remove the south central rolling support and slide the new Be section north taking care to support the south and north ends of the pipe manually and making sure the north end stays centered on the CM axis. Attach the north bellows and 1 5/8 to 3" transition section. Attach the new north end BP support to the north end of the 1-5/8 to 3" transition.

6. With assistance from the CAD survey group make appropriate adjustments to the new north end BP support and CM north rolling support to align the new central beampipe section to the nominal beamline axis. (For this step and the following steps where survey or alignment is discussed, see the next section for more detailed info on beampipe alignment)

7. Make sure that the south end of the new central beampipe has adequate clearance and is properly centered within the CM, then move CM north until the south end of the central beampipe section passes the location for the south central rolling beampipe support, then install the south central support and and, with assistance from the CAD survey group adjust the south central support to maintain alignment of the central beampipe with the nominal beamline axis.

8. Move the CM to run position. Take care to support observe the beampipe while moving and assure that it remains centered on the CM axis and that there are no impediments to its translation through the CM.

9. Preassemble the 1 5/8 to 3" transition, the south bellows and the south 3 to 5" transition sections of the beampipe and leak test the connections. Outfit the 3-5" transition section with rolling support, bakeout heaters, bakeout blanket and bakeout instrumentation.

10. Move MMS into IR east area. Slide the assembly from the previous step into the MMS from the north side and field fabricate temporary supports for both the north end of assembly in the MPC cavity and south end of the MMS in the MuID collar area.

11. Move the MMS west until the roller supports align with the north south tracks. Jack up the east side of the MMS and rotate the roller supports 90 degrees to align with the north-south tracks, then lower the jack to restore support from the rollers. Do the same for the west side. The MMS should now be in alignment with the beamline axis.

12. Move the MMS south as far as possible.

13. Pull the assembly north through the MMS and push it into the CM until it just touches the new central beampipe. Take care not to push it any further. Attach the new south 1-5/8 to 3" transition beampipe support in the flowerpot region and make sure it loosely supports the beampipe but will not snag when the CM is moved south.

14. Remove the south central rolling beampipe support and move CM south. Take care to ~~manually~~ support the Be/Alum BP in the CM region during the CM move.

15. Attach the assembly residing in the MMS to the central BP in the CM region.

16. Make sure that the south end of the new central beampipe has adequate clearance and is properly centered within the CM, then move CM north until the south end of the central beampipe section passes the location for the south central rolling beampipe support, then install the south central support.

17. Tighten the south 1-5/8 to 3" transition beampipe suppport and check the alignment of the beampipe, making adjustments as necessary. Make adjustments to the CM rolling supports so that these 2 supports serve only to take any nominal bow out of the beampipe and do not influence the beampipe alignment.

18. Move MMS into Run position taking care to assure that the south 3"to 5" transition section of the beampipe does not get snagged or otherwise be dragged north by the movement of the MMS.

19. Attach the last section of the beampipe, the 5" spool section.

E. Alignment and Initial Survey

Axial alignment of the central section of the PHENIX beampipe is critical owing to its small size relative to other sections of the PHENIX beampipe. Alignment in the axial direction is less critical and is determined by the accuracy of the individual beampipe sections. This axial alignment is to be accomplished by the PHENIX installing techs who shall mechanically measure and verify that the beampipe is centered in the CM to +/- 1 mm when the CM is in the run position. If not then some adjustment of the north and south bellows positions is necessary.

The radial alignment and pitch and yaw of the central beampipe shall be measured by CAD survey group using the PHENIX designed survey target holders. (See the attached illustrated beampipe installation plan.) Adjustment is made in the north by adjusting the north 1-5/8 to 3" beampipe support, while adjustment on the south side is made using the south 1-5/8 to 3" beampipe support. The 2 central beampipe section rolling supports are to be used in conjunction with the north and south adjustments to assure that any sag in the beampipe is corrected. Since the north and south supports

cannot be adjusted simultaneously care must be taken to make appropriate use of the central rolling supports as temporary adjusting features.

F. Bakeout

After the new beampipe, spool, transitions and bellows are all in place connected and pumped down to vacuum, the new sections shall be baked to 200ºC for a period of time determined by the CAD vacuum group. The CAD vacuum group shall be responsible for work planning of this task. (Refer to SS-2010-189.)

G. Leak Test

After bakeout the entire new beampipe assembly shall be vacuum leak tested. The CAD vacuum group shall be responsible for work planning of this task.

H. Restore Dislocated PHENIX subsystems

After leak test, re-install the north and south BBC and MPC detectors. (see Work permit DRL-2010-7 and DRL-2010-8 for more information.)

I. Final Survey

After all detectors have been re-installed, and after the CM has been moved north for the final time in the 2010 shutdown, but before the MMS has been moved north, a final survey shall verify that the central beampipe targets indicate that the 2 points on the axis of the central beampipe related by the 2 targets are aligned with the nominal beamline axis to within +/- 0.2 mm. If necessary, the CM may be moved south to make corrections to the north support then north to make corrections to the south support until the desired alignment is achieved. There shall be no further moving of the CM prior to the next run, else the final survey shall be repeated. It is anticipated that a final survey of the central beampipe position shall be required after each subsequent shutdown during which moving of the CM occurs.

New Beampipe Installation Plan

Beampipe installation procedure and Choreography of Major PHENIX Components

Don Lynch

June 30, 2010

New Beampipe Installation Plan

Beampipe installation details

- Introduction
- Design
- Removal of existing Beampipe components
- Installation of new beampipe components
- Beampipe alignment
- Vacuum preparation and testing
- Final survey

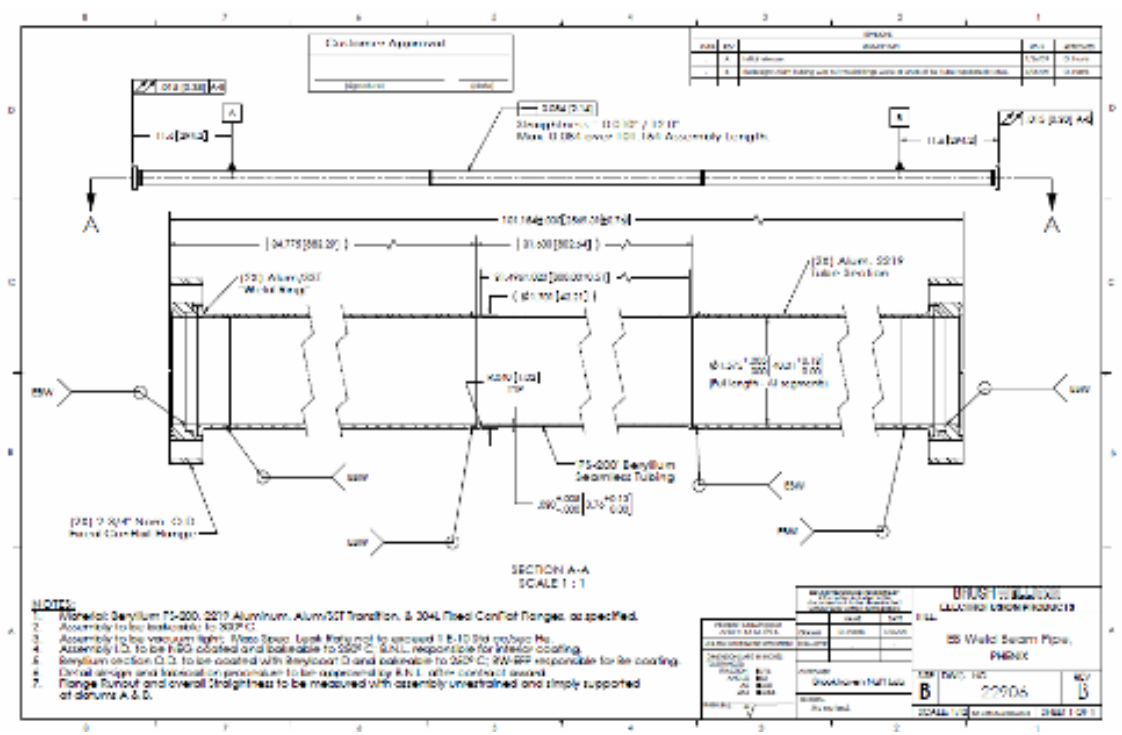
New Beampipe Installation Plan

Introduction

The PHENIX experiment at RHIC requires a new Beryllium beampipe in the Central Magnet with a significantly smaller diameter than the existing beampipe. This is required to alow the new PHENIX VTX detector to have components closer to the ineraction point (IP) in PHENIX. Removal and replacement of the existing beampipe required redesign of other adjacent PHENIX beampipes to allow for the transition from a larger diameter (nominally 3 inches OD) to the new smaller diameter (nominally 1-5/8 inches OD). The procedure for removal requires additional portions of the beampipe to be removed to gain access to the central beampipe and this affords the opportunity to replace all PHENIX existing beampipe sections between the north and south isolation gate valves (except bellows) with improved NEG coated components. This installation plan describes the procedures to accopmplish these tasks.

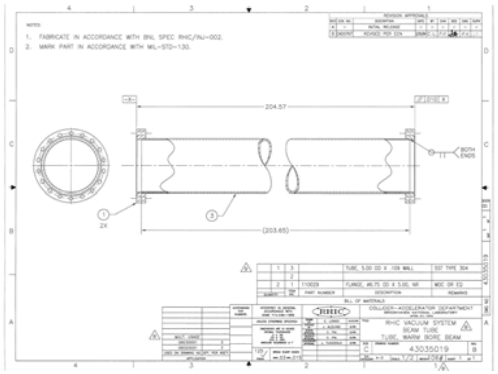
New Beampipe Installation Plan

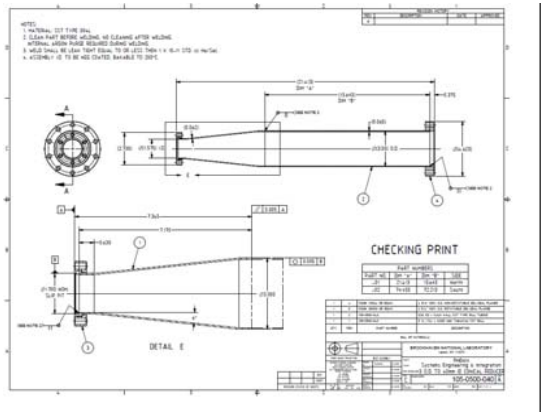
Design

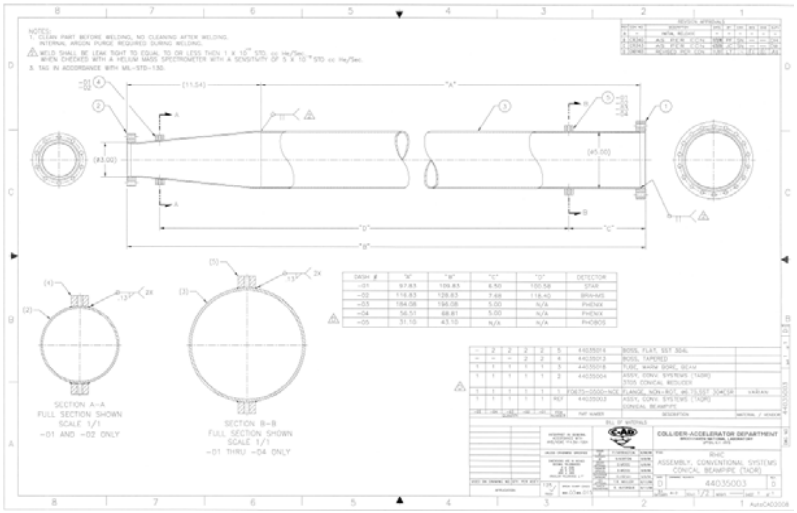


Central Beryllium /Aluminum Beampipe with Stainless transitions

New Beampipe Installation Plan

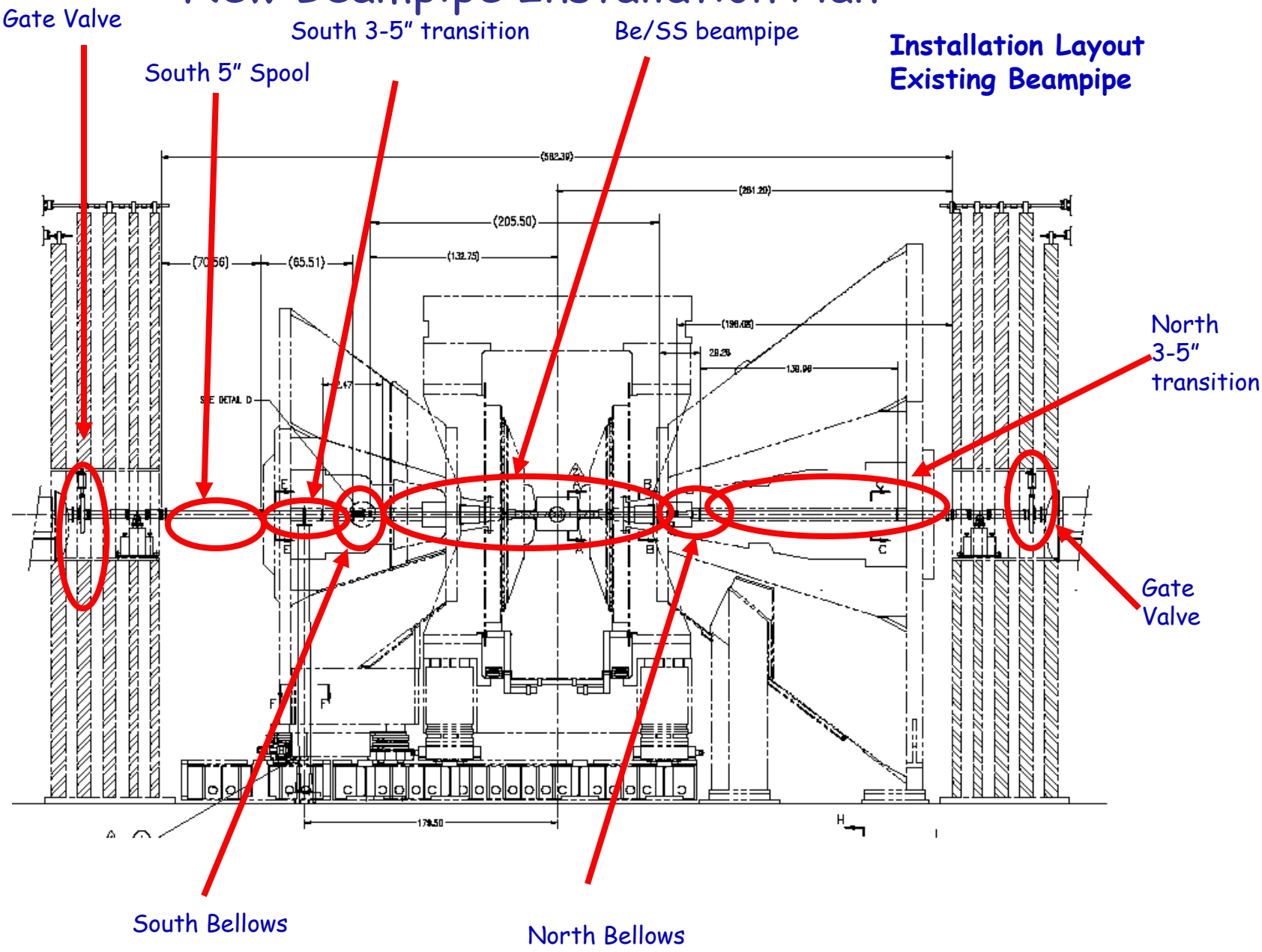






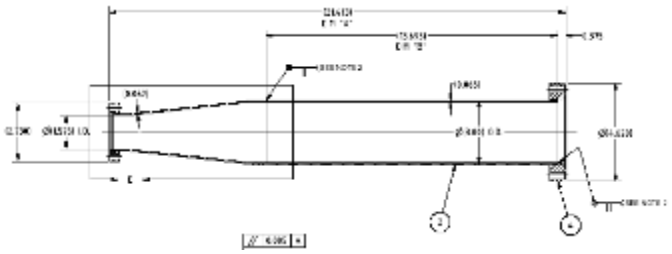
New Stainless steel
Beampipe components

New Beampipe Installation Plan

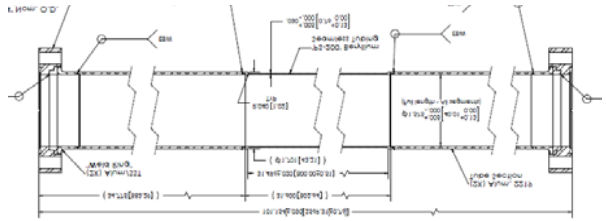


New Beampipe Installation Plan

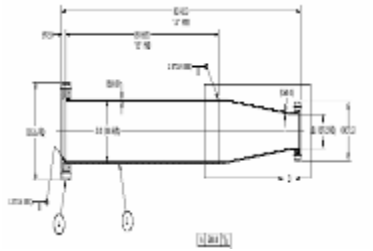
South 1-5/8 to 3 " transition, 79.93" long

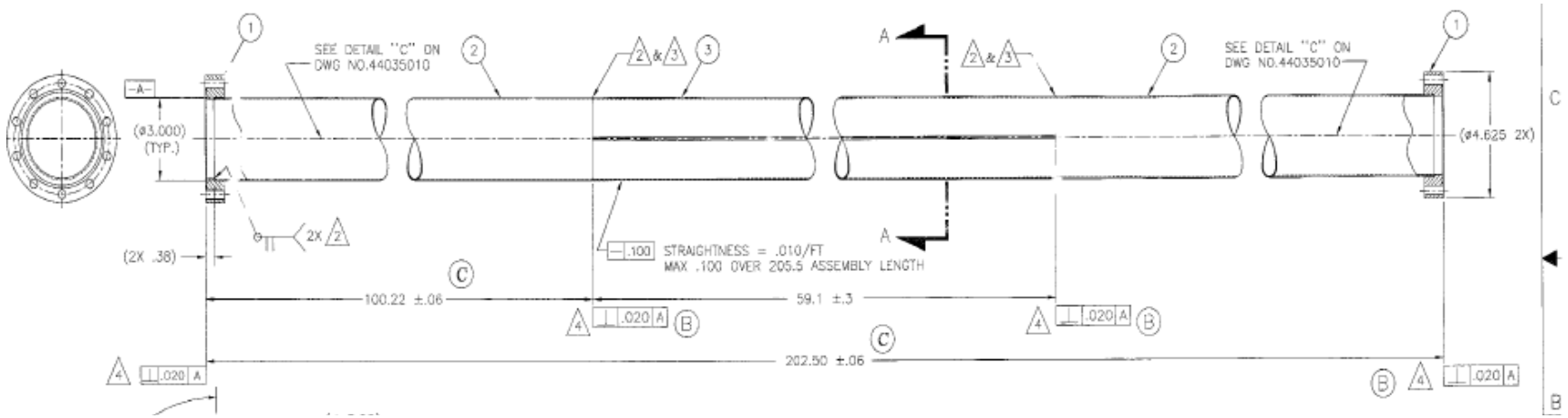


New Be/Alum BP, 101.15" long



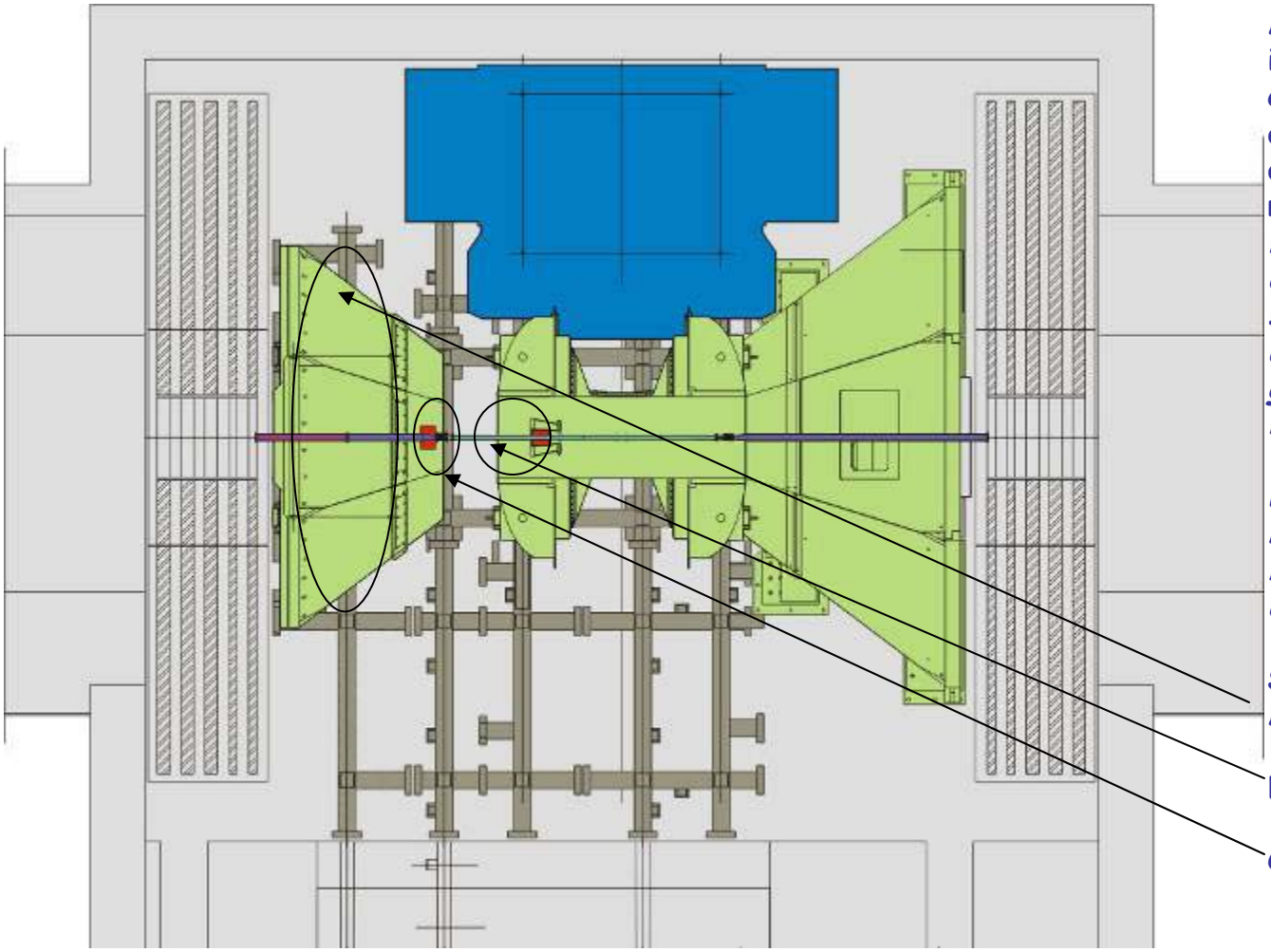
South 1-5/8 to 3 " transition, 21.41" long





Existing Be/SS Beampipe 202.5" long replaced by three beampipe sections (see above)

New Beampipe Installation Plan



After normal shutdown tasks including removing the MuID collars, moving the EC to the AH and all other shutdown prep activities, we will be ready to remove the existing beampipe. *Before commencing with removal of the existing beampipe sections verify that both north and south PHENIX beampipe gate valves are closed and locked in the closed position for the duration of the beampipe upgrade effort. The HBD and RXNP detectors shall already have been removed from the CM area.*

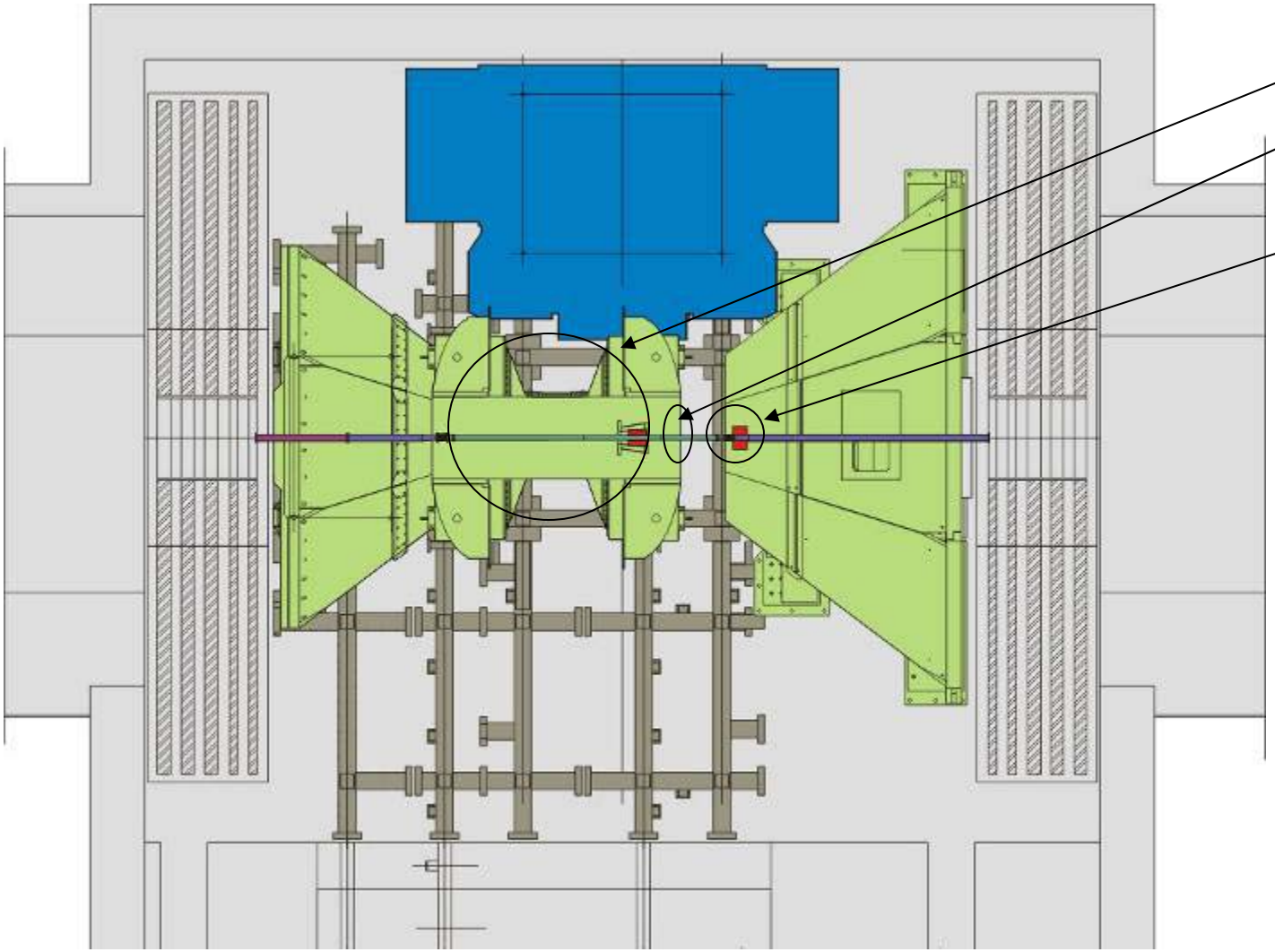
Step 1

A. move the MMS south.

B. Remove the south MPC

C. remove the south BBC.

New Beampipe Installation Plan

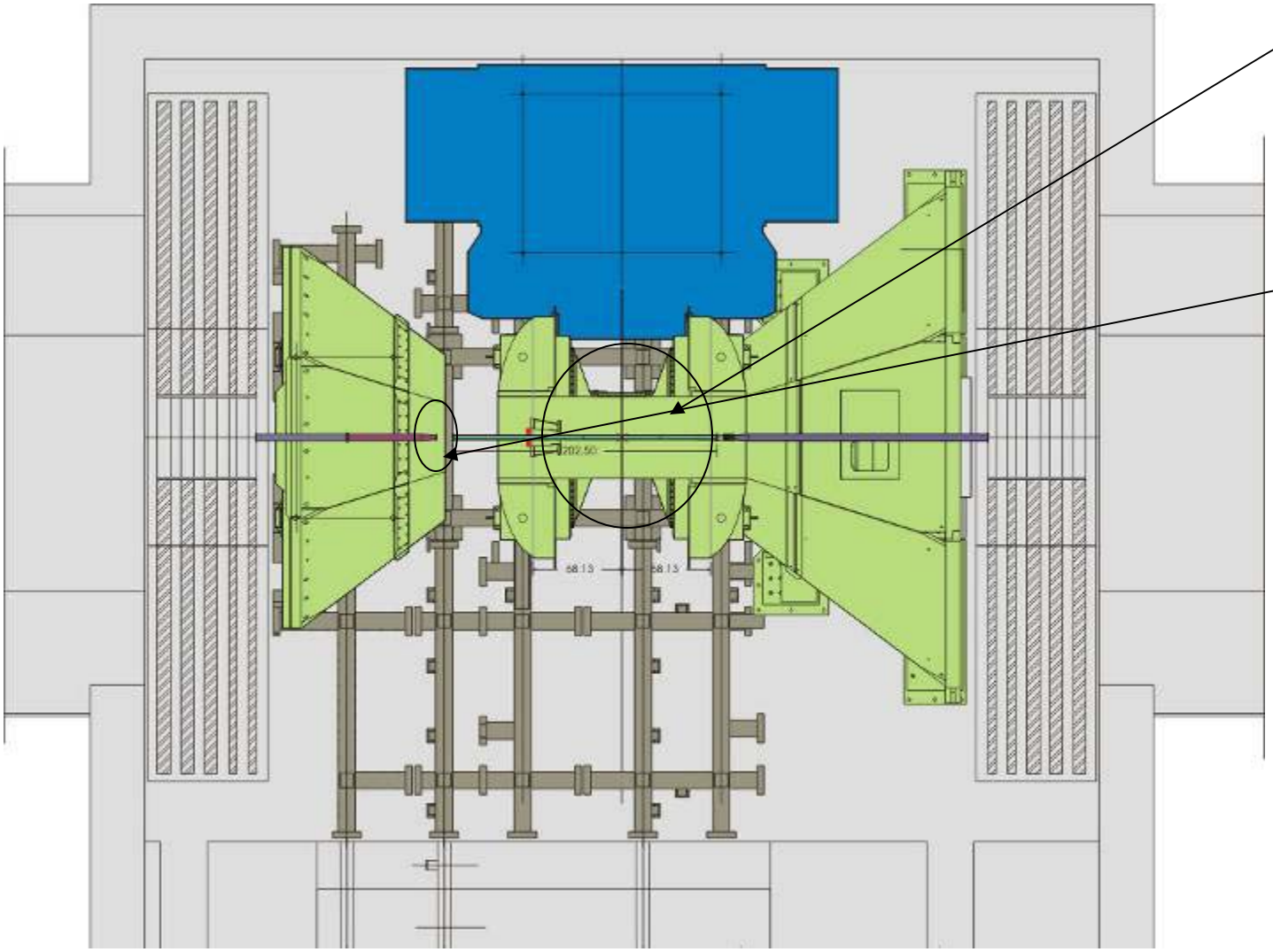


Step 2
A. move the CM south.

B. Remove the north MPC

C. remove the north BBC.

New Beampipe Installation Plan



Step 3
A. move the CM to run position.

B. CAD Vacuum techs bleed up to atm.

C. Remove the south bellows. Temporary support of the south 3-5 inch transition section will be necessary. This is a field adjustment.

In this step and each subsequent step where a vacuum component is removed, backfill the section with N2 gas, cap the ends with aluminum foil and plastic caps and seal with tape and do the same for the mating section of BP which is not (yet) removed. Components which will not be reused with the new BP shall be delivered to the CAD vacuum group for safekeeping.

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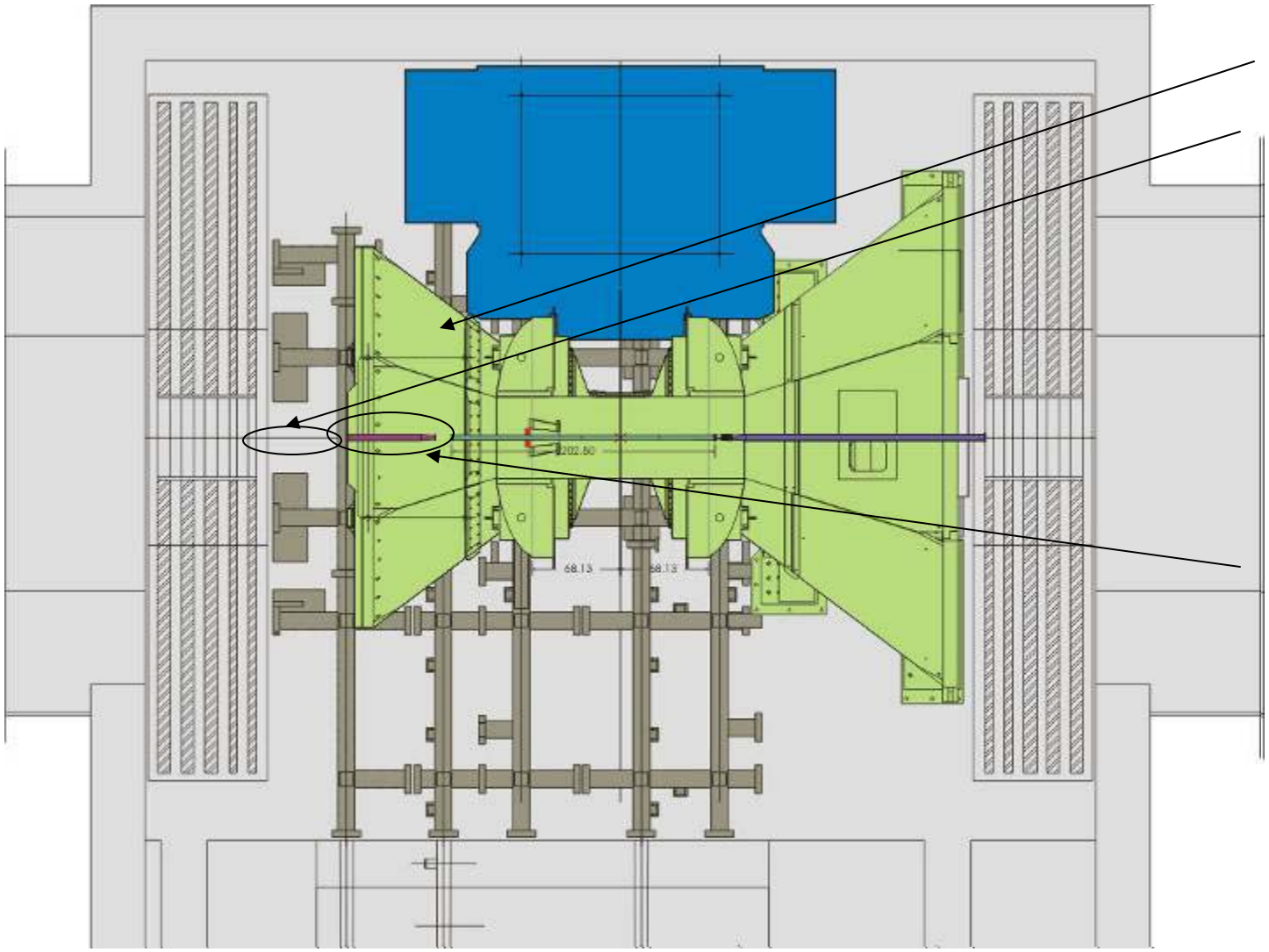
New Beampipe Installation Plan



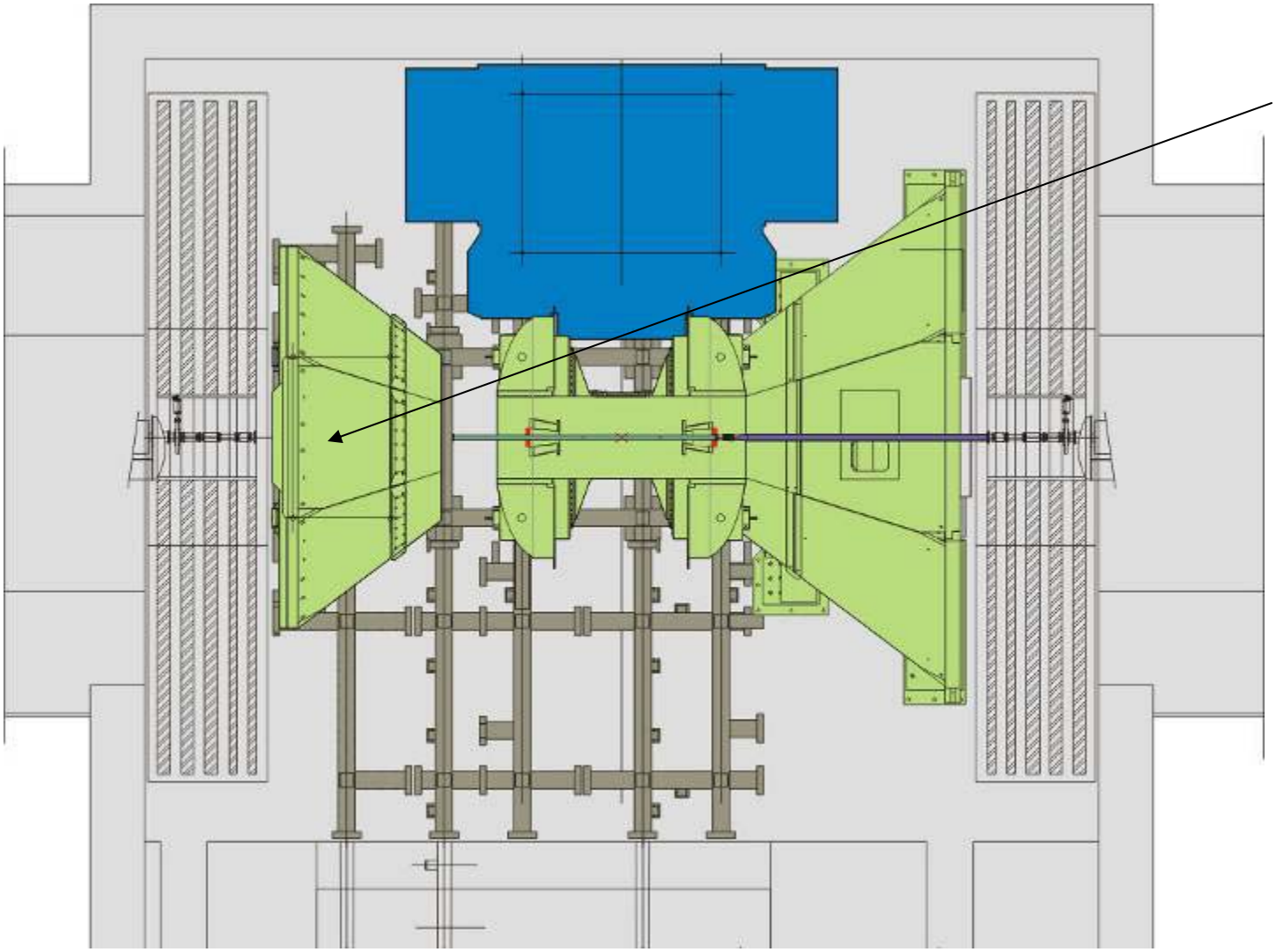
Step 4

A. move the MMS north.

B. PHENIX techs remove the south spool section. This will require temporarily supporting the adjacent beampipe sections (Be/SST BP in the CM region and the 3"-5" transition on its south end.) as necessary. This will be a field djustment.

C. remove the south 3"-5" transition.

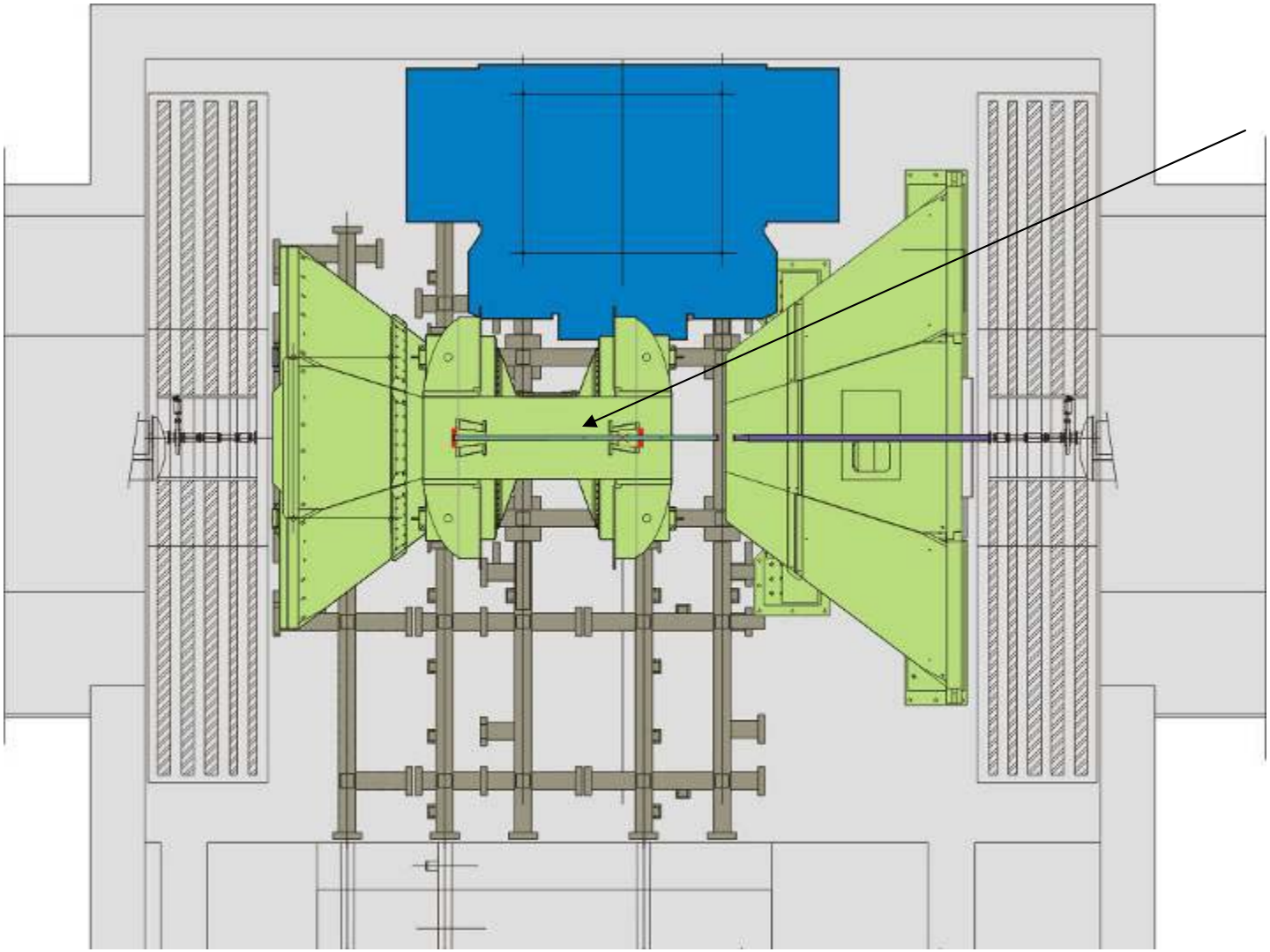
New Beampipe Installation Plan



Step 5

Move the MMS south.

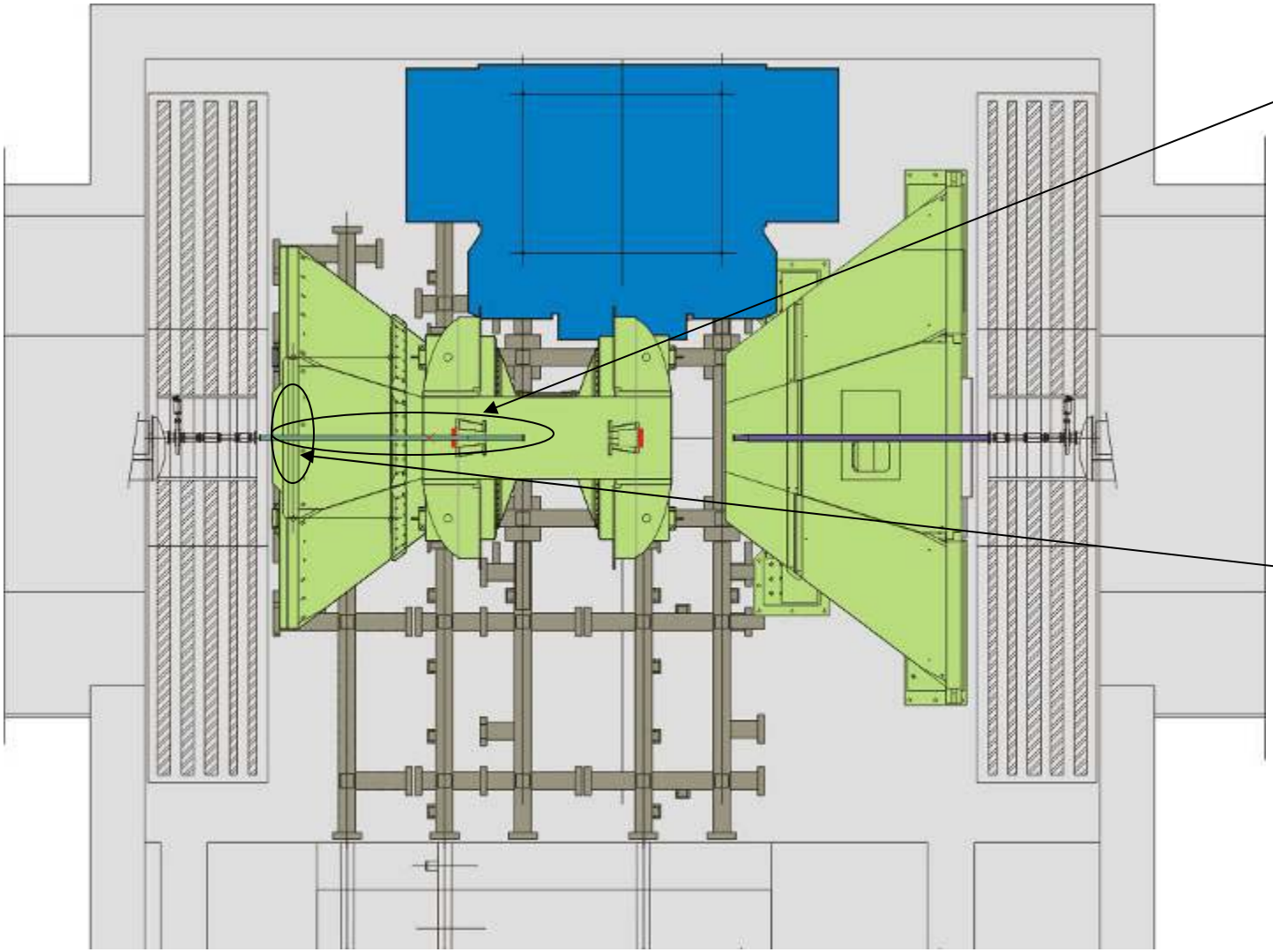
New Beampipe Installation Plan



Step 6

Move the CM south. Remove the north bellows. A field adjustment to the CM temporary support of the BE/SST BP while moving the CM will be necessary.

New Beampipe Installation Plan

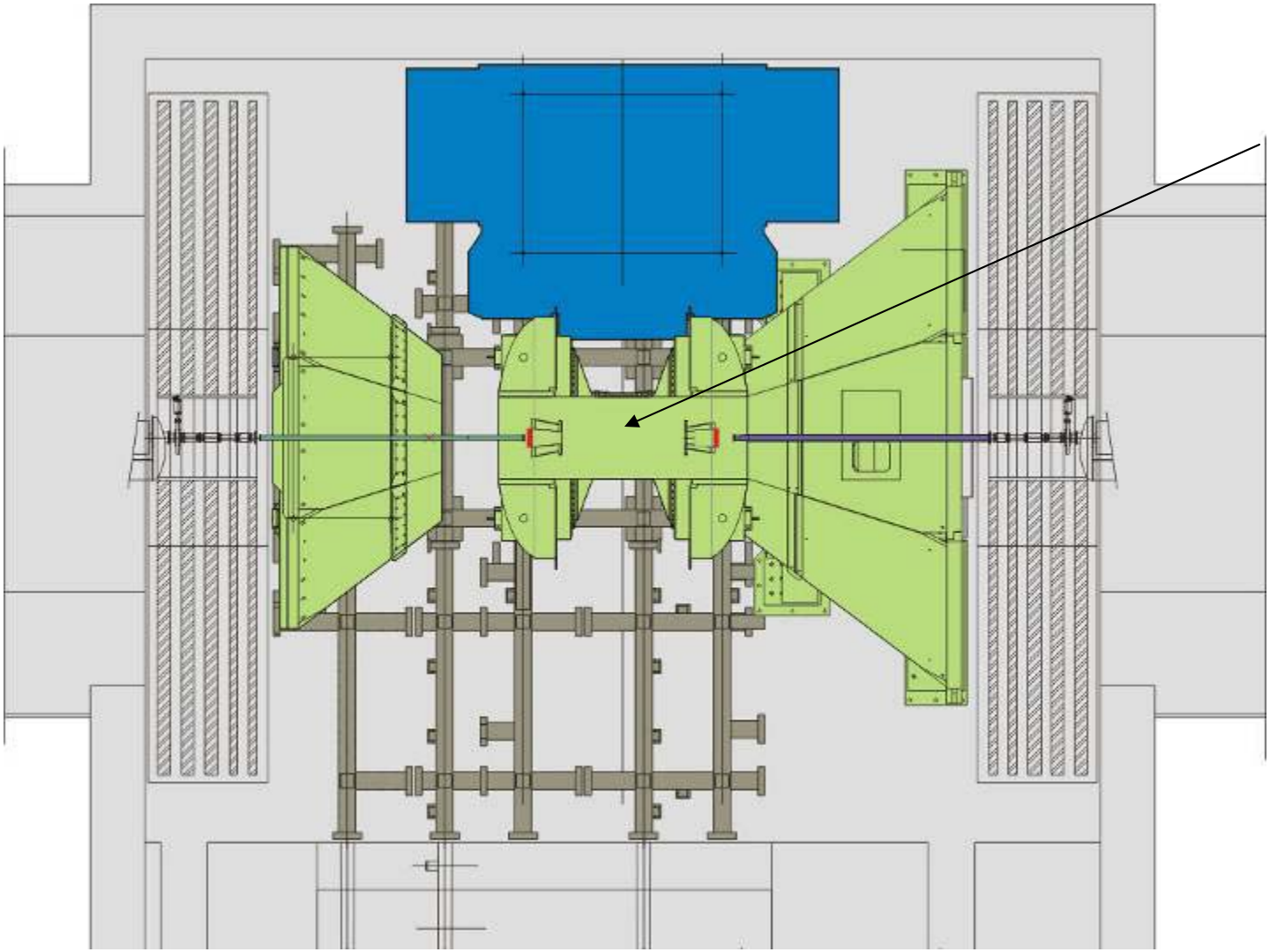


Step 7

Slide the current Be/SST BP from CM to MMS. Modification to the field adjustment supporting the Be/SST BP will be necessary.

PHENIX Techs will need to access the square hole in the MuID detectors throuh the south RHIC tunnel to make temporary field adjustments for support of the Be/SST BP south end of theMMS.

New Beampipe Installation Plan

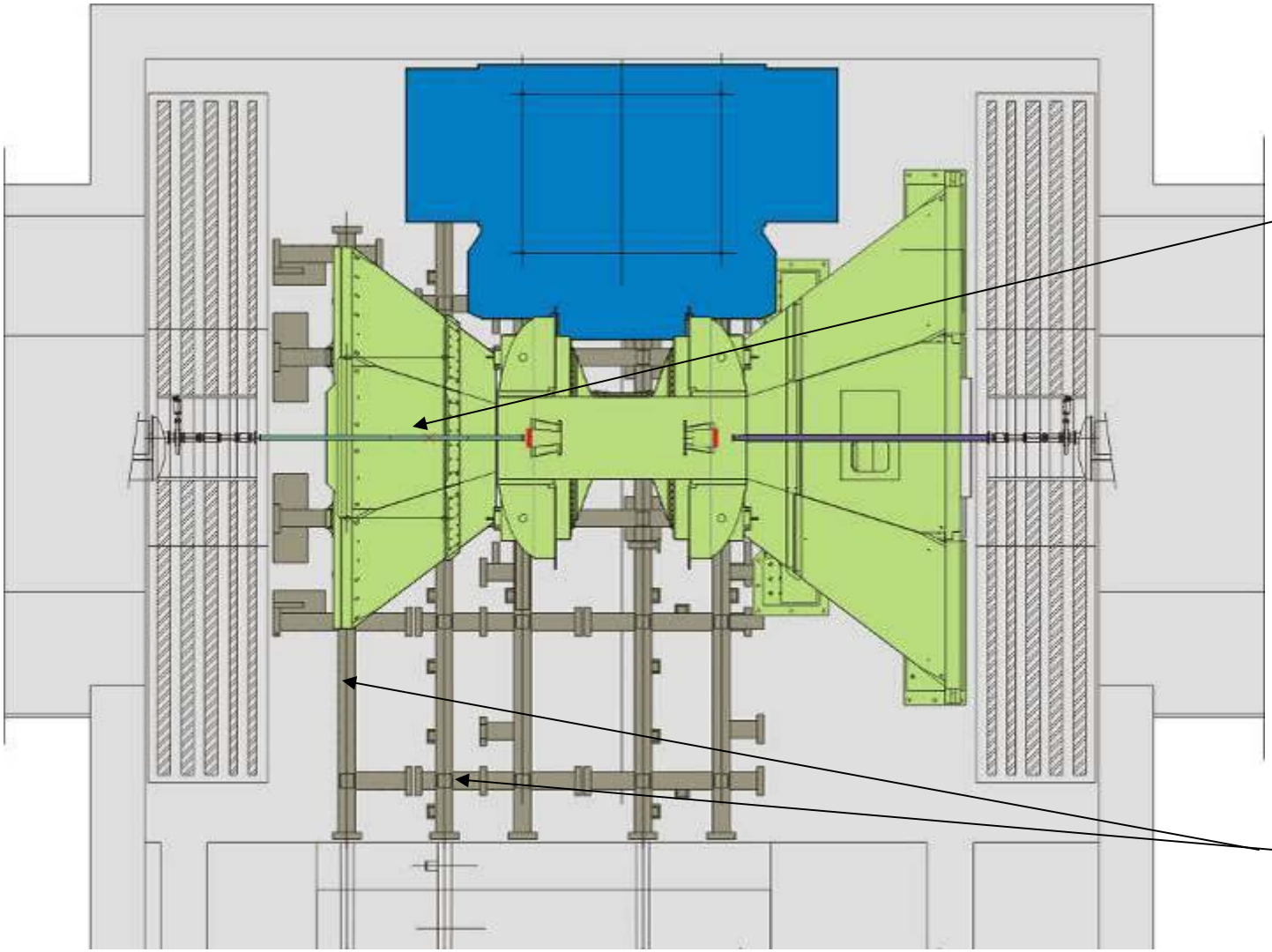


Step 8

Move the CM back to the run position

Field adjustment to support the Be/SST BP in station 1 south

New Beampipe Installation Plan

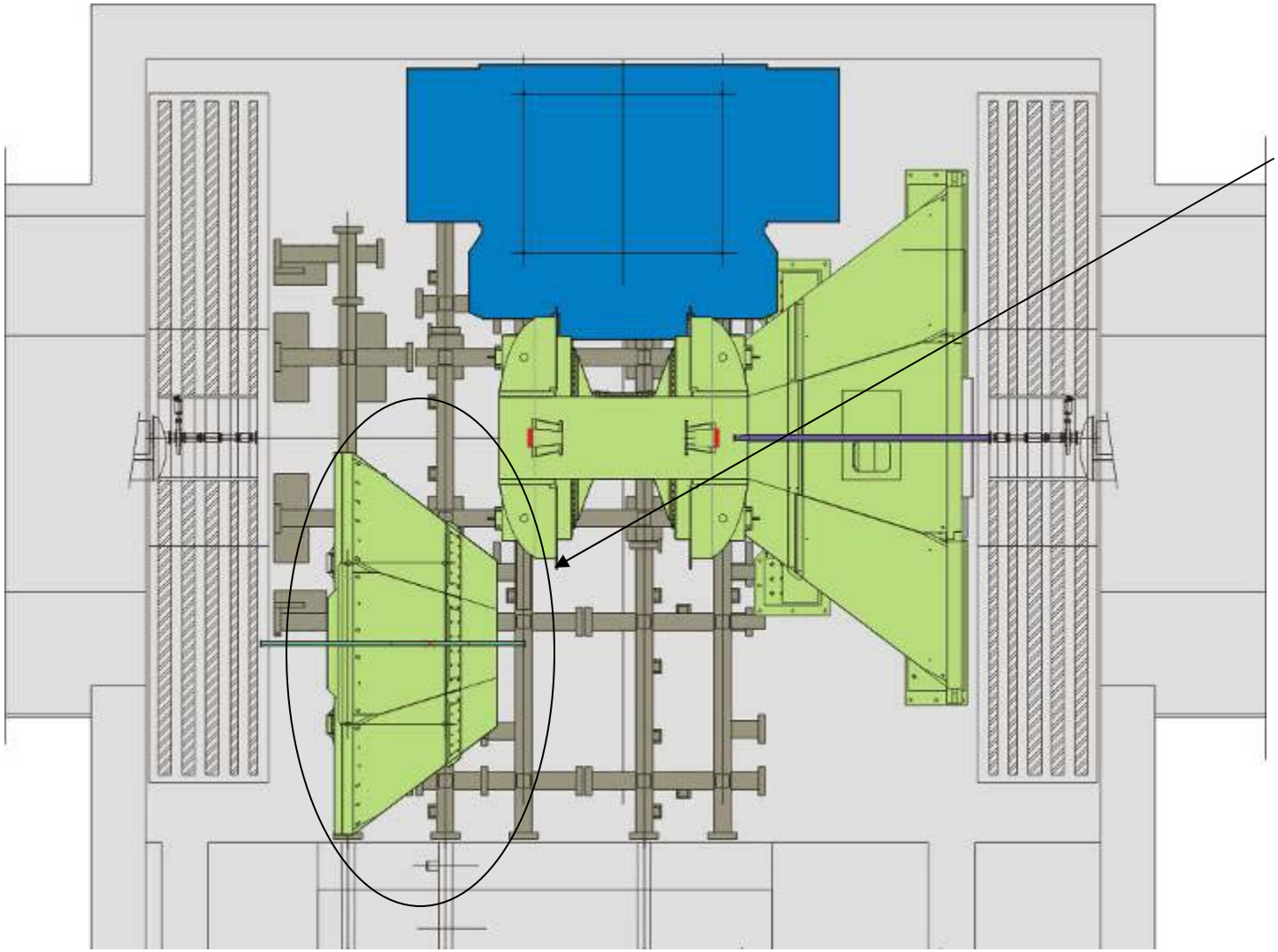


Step 9

Position the MMS for move to AH and PHENIX techs will disconnect gas, water, air, optical and electrical services to the MMS. All services must be disconnected and stowed safely where they will not be damaged during the MMS moves. GLink/ CLink crates and MPC Crates must be moved so as not to be decapitated by the Shield wall ledger when passing through the sill. This will be coordinated by PHENIX technicians with MPC experts as worker planned work.

MMS will ride out on these tracks.

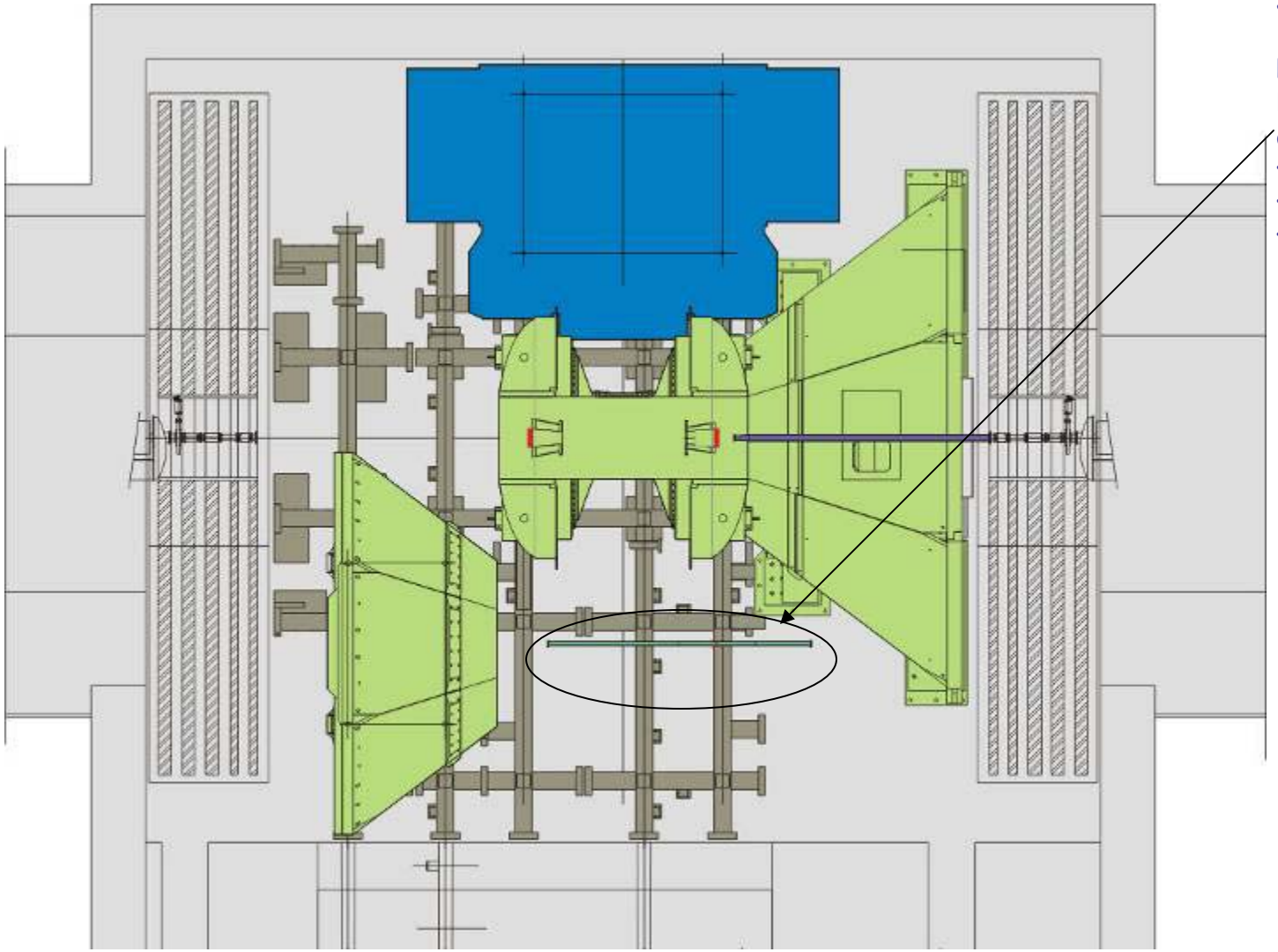
New Beampipe Installation Plan



Step 10

Move MMS east for removal of Be/SSt BP

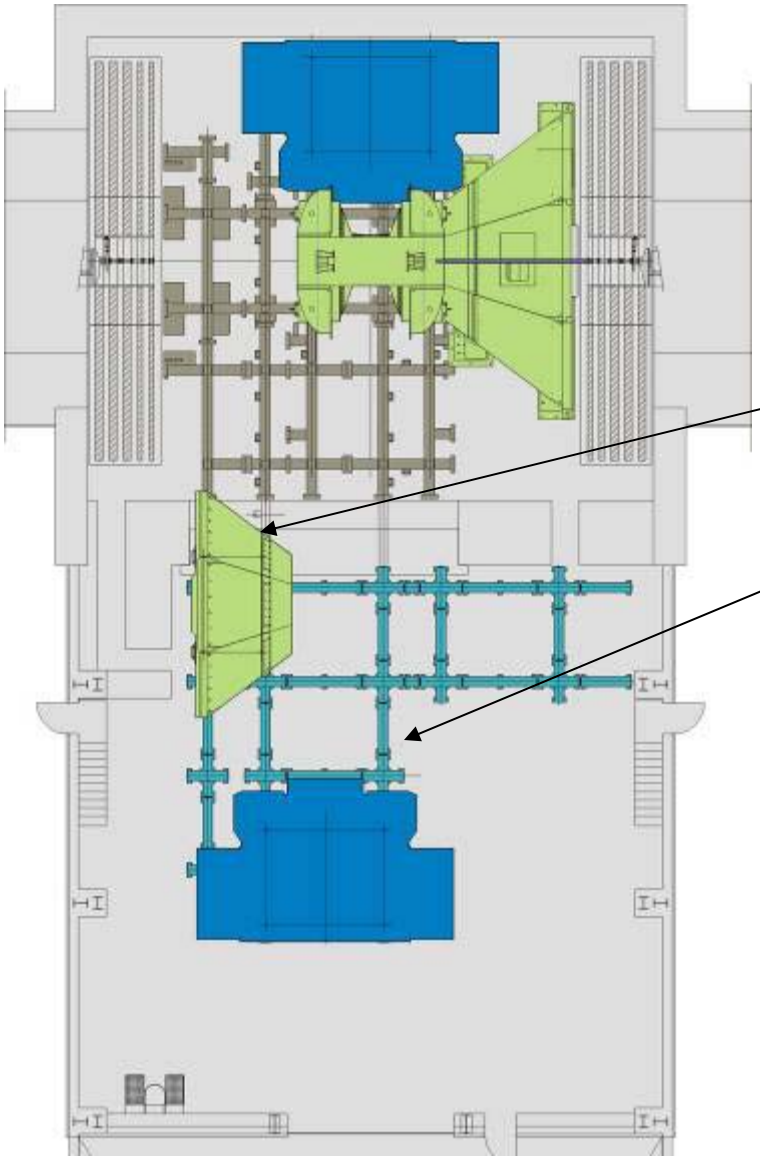
New Beampipe Installation Plan



Step 11

Remove Be/SSt BP, Backfill with N2, cap and seal the BP with foil, plastic caps and fix them in place with tape.

New Beampipe Installation Plan

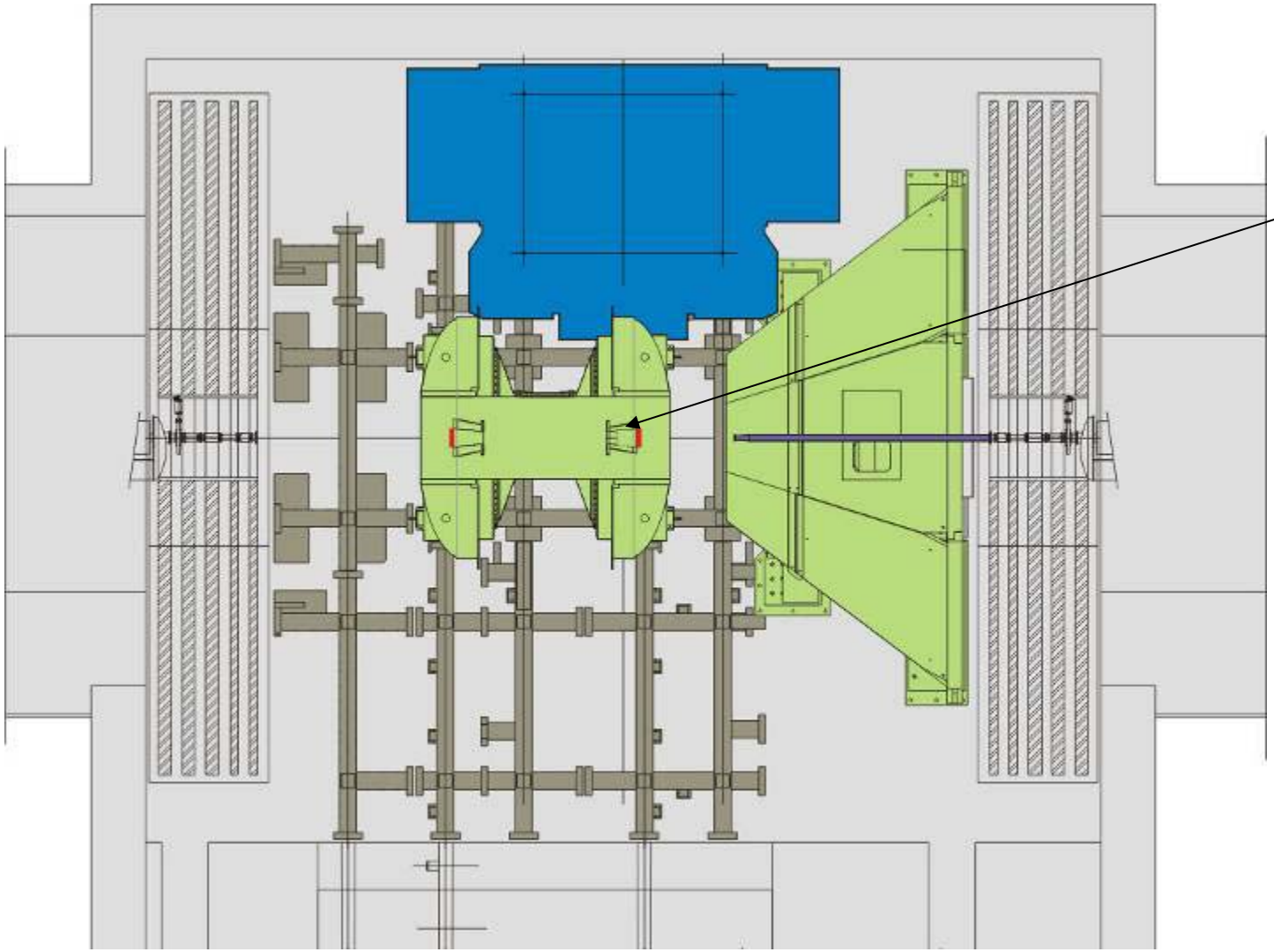


Step 12

Move the MMS to AH

Note: the EC is already in the AH

New Beampipe Installation Plan

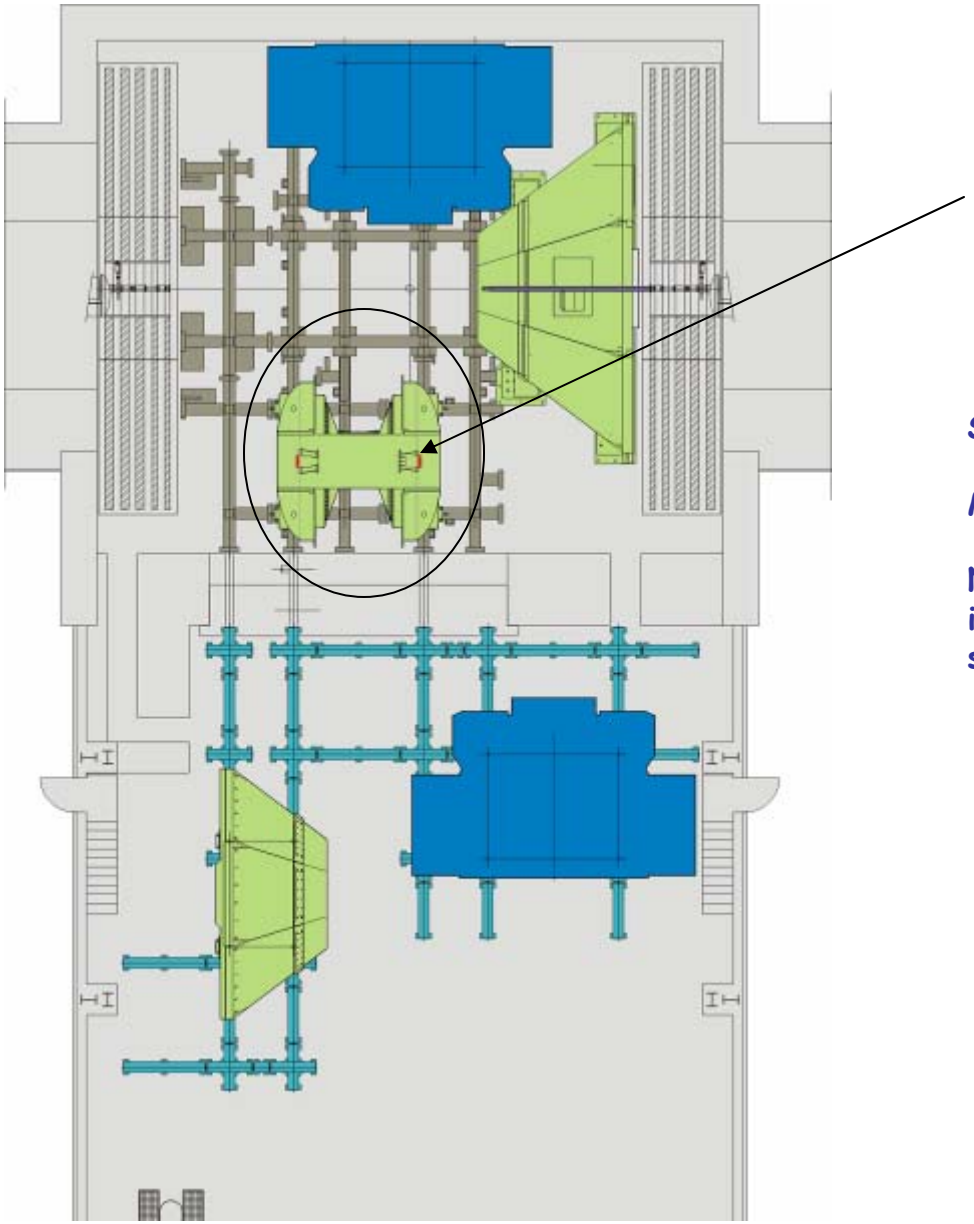


Step 13

Position CM for move east

Disconnect all services and prep CM for move east taking care that no services could be damaged during move.

New Beampipe Installation Plan

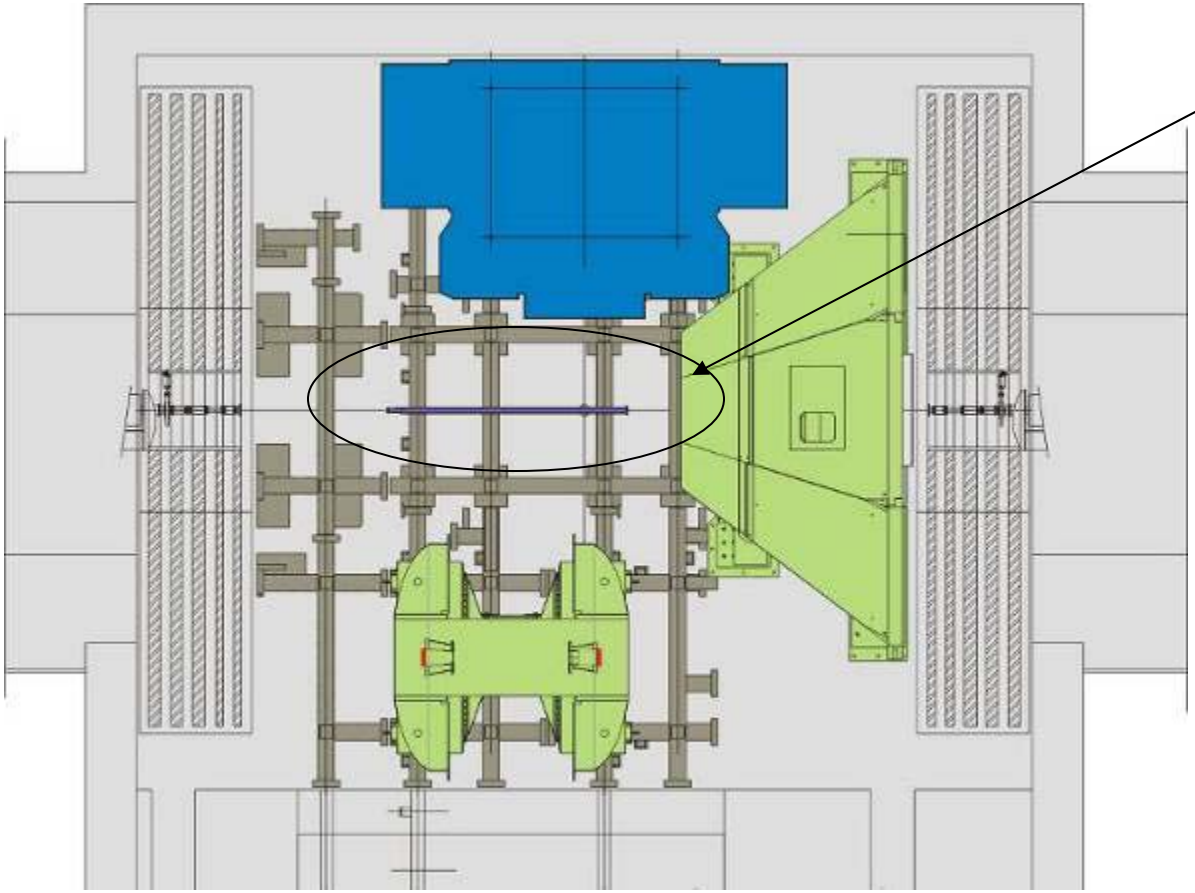


Step 14:

Move CM to east area of IR

Note: CM does not move past the sill so it is not necessary to knock down any full size racks.

New Beampipe Installation Plan



Step 15:

Remove Beam Pipe Section from MMN Backfill with N2, cap and seal the BP with foil, plastic caps and fix them in place with tape.

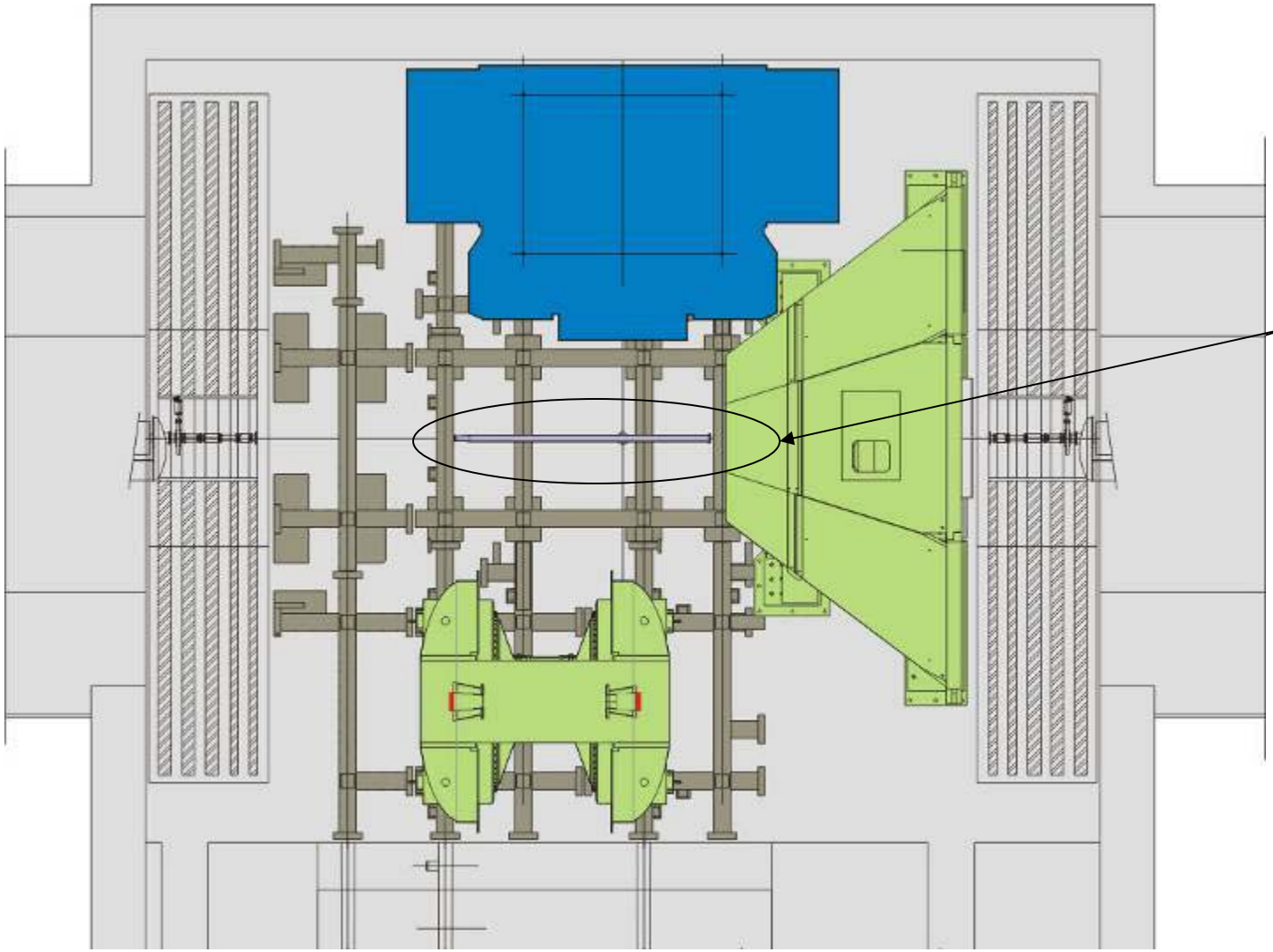
At this point the old beampipe parts have been removed and PHENIX techs could be ready to begin installation of the new beampipe at this time. However, there are several maintenance/ repair/upgrade tasks which are more convenient, safer and more reliably accomplished at this time. Therefore the Large PHENIX detector components will remain in this configuration while these tasks are accomplishec. The tasks include DC, PC1, MuTr and MuTrigger FEE troubleshooting, maintenance and repair and installation of the new RPC absorber upgrade. Each of these tasks is planned separately and has its own work permit(s)

New Beampipe Installation Plan

Installation of the new PHENIX beampipe components

After completion of the maintenance/repair/upgrade tasks for other PHENIX equipment discussed in the previous step, Installation of the new PHENIX beampipe components may commence.

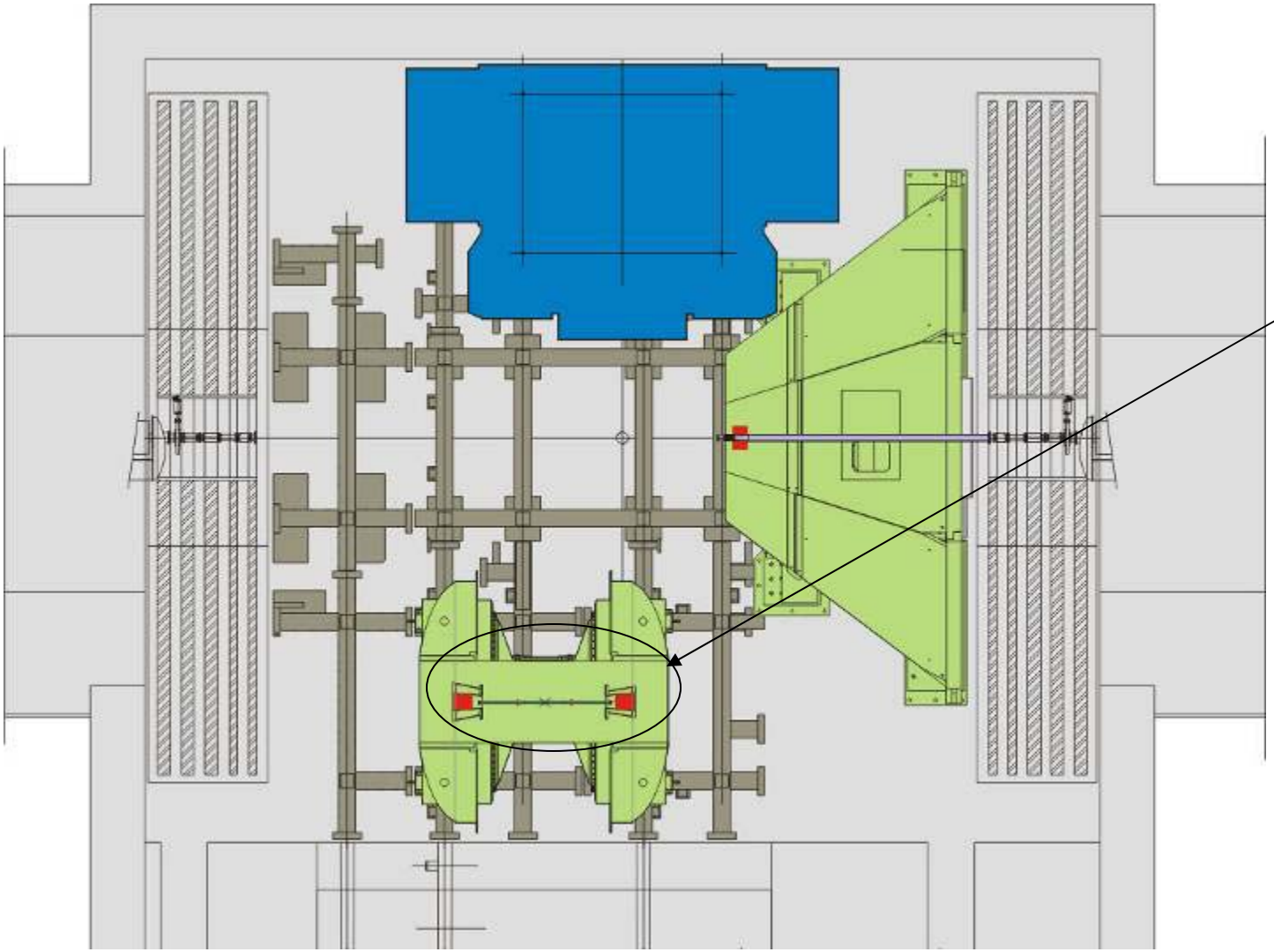
New Beampipe Installation Plan



Step 16:

Install New NEG Coated 3-5" transition Beam Pipe Section in MMN. Rolling supports, bakeout heaters, bakeout TC's, and bakeout blankets shall be on the BP section when installed. A PHENIX tech shall be in the square hole in the MuID detectors to position and attach the new BP to the existing sections.

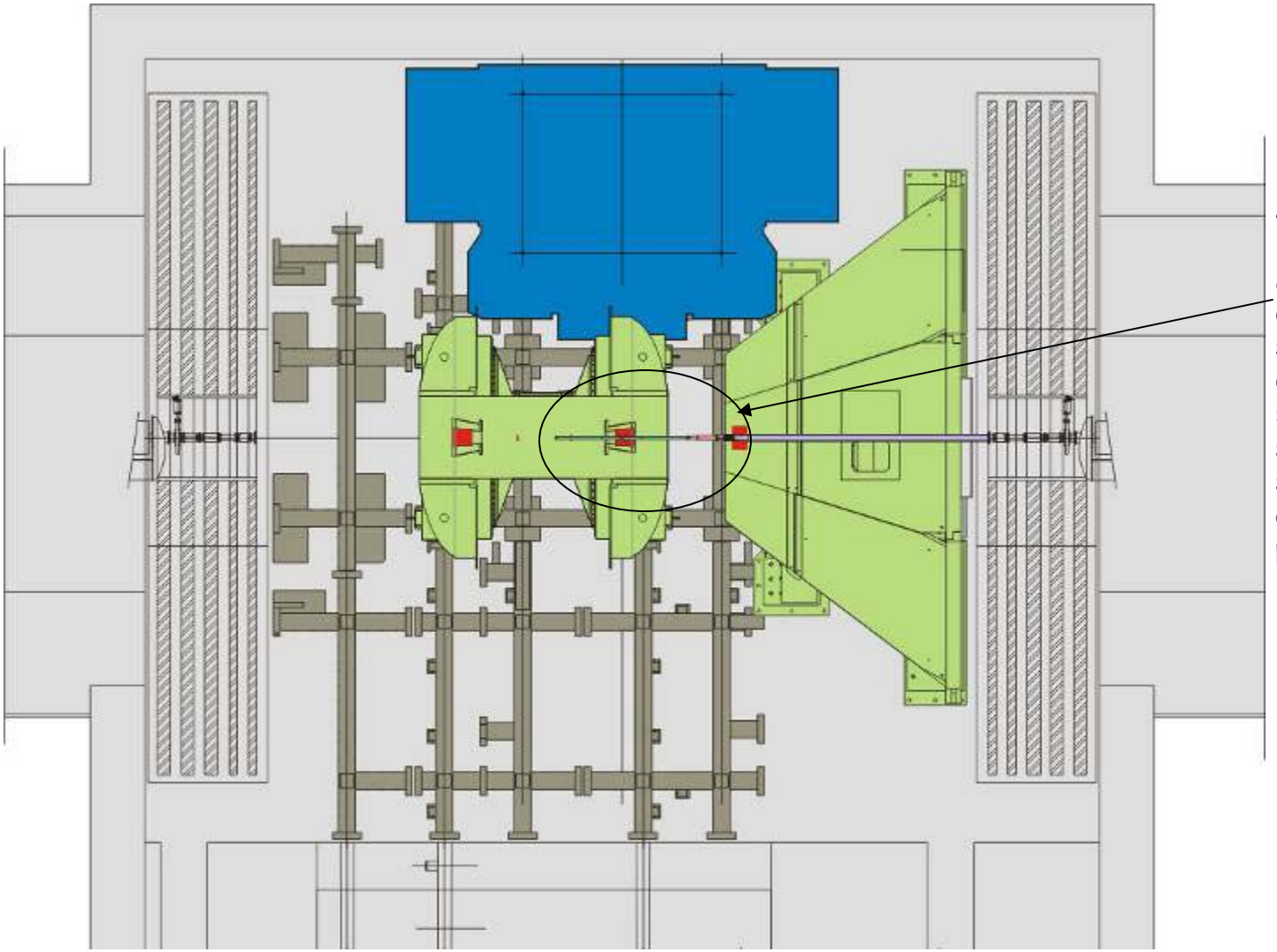
New Beampipe Installation Plan



Step 17:

Install New Be section in CM with new central area rolling bp supports in place

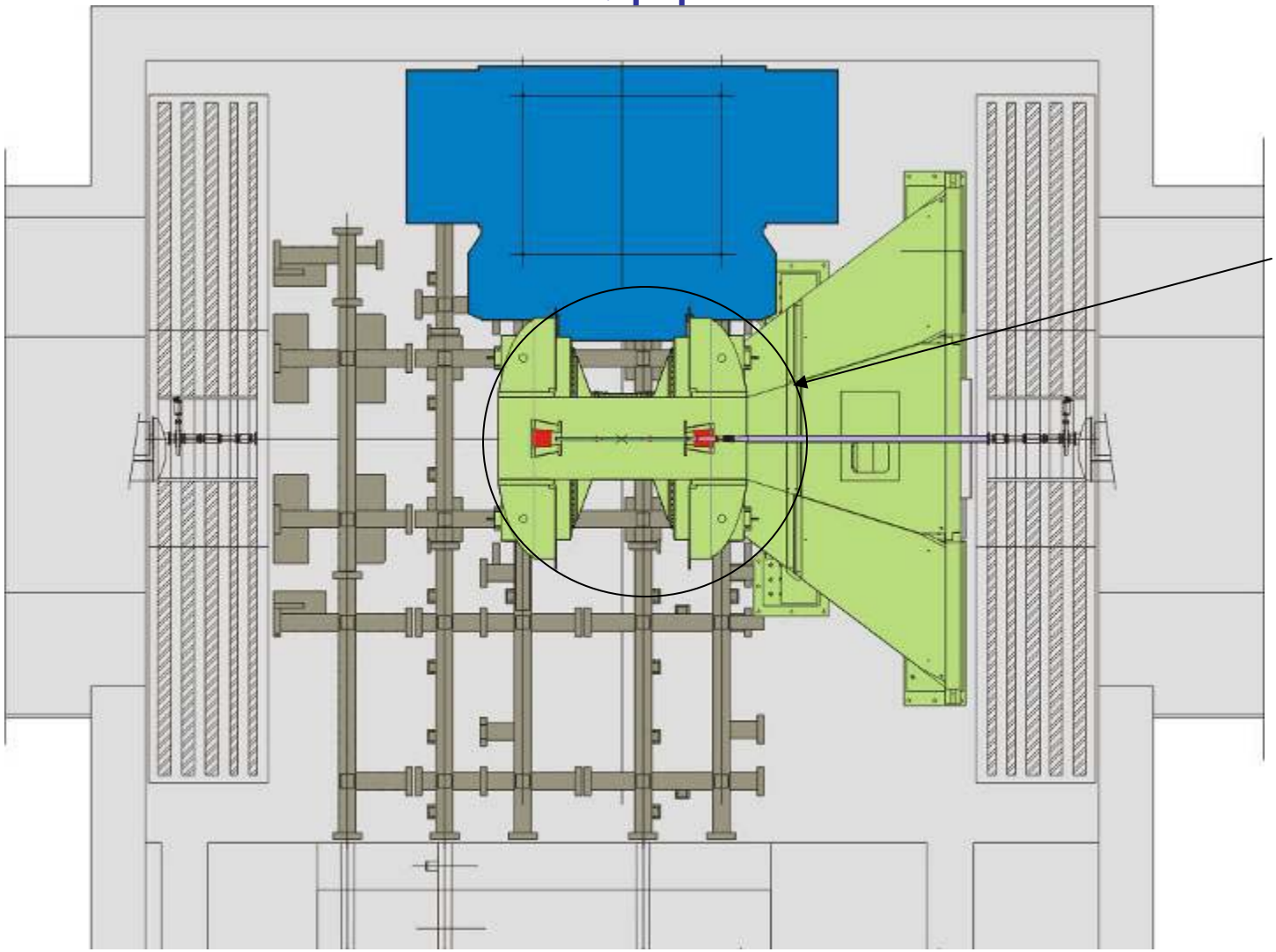
New Beampipe Installation Plan



Step 18:

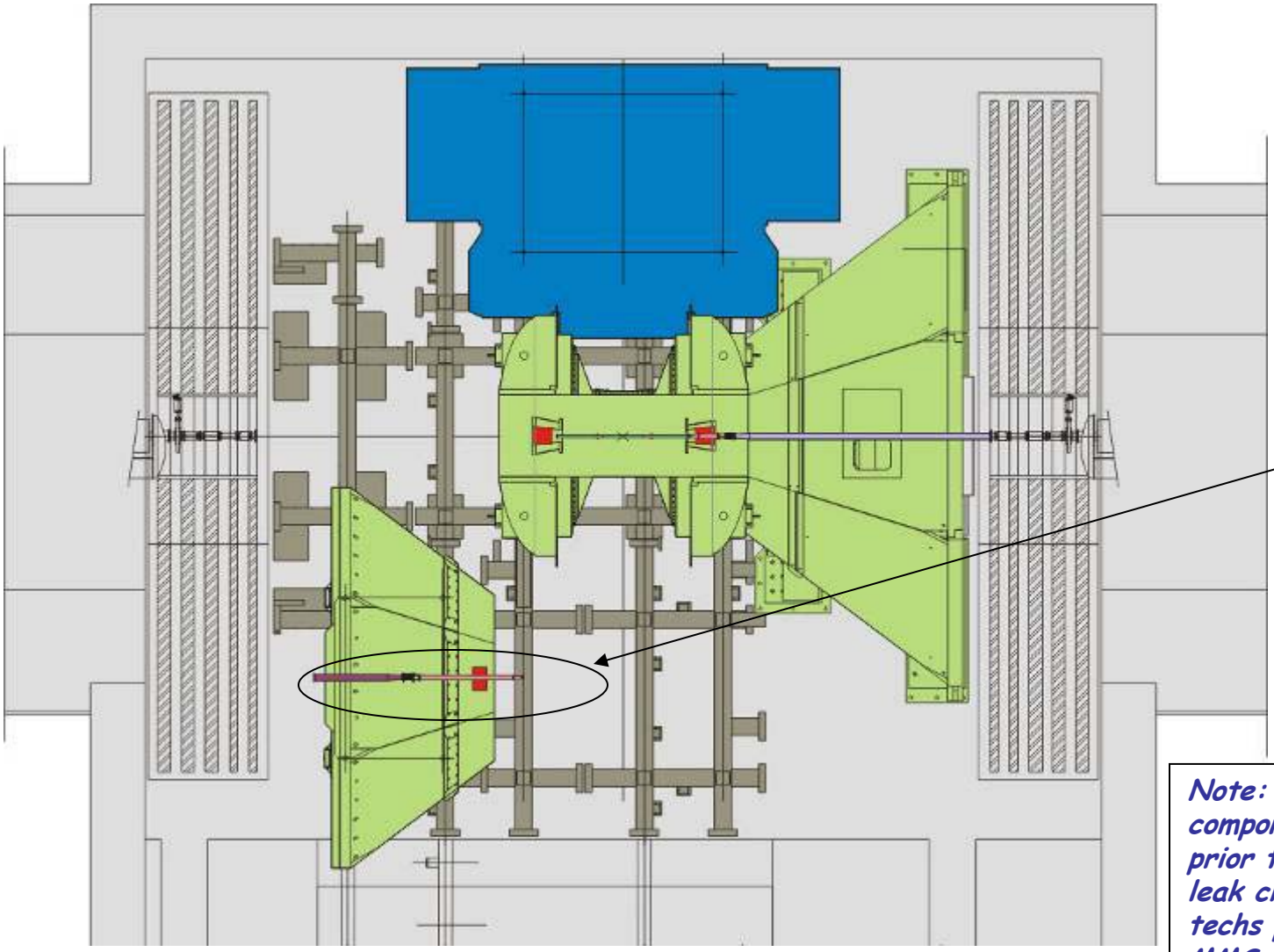
Move CM into beamline axis. Slide new Be section north and attach bellows and 1 5/8 to 3 transition section. Set beampipe support to best estimate for final position

New Beampipe Installation Plan



Step 19:
Move CM to run position. Take care to support Beampipe while moving and set it upon the south central CM support

New Beampipe Installation Plan

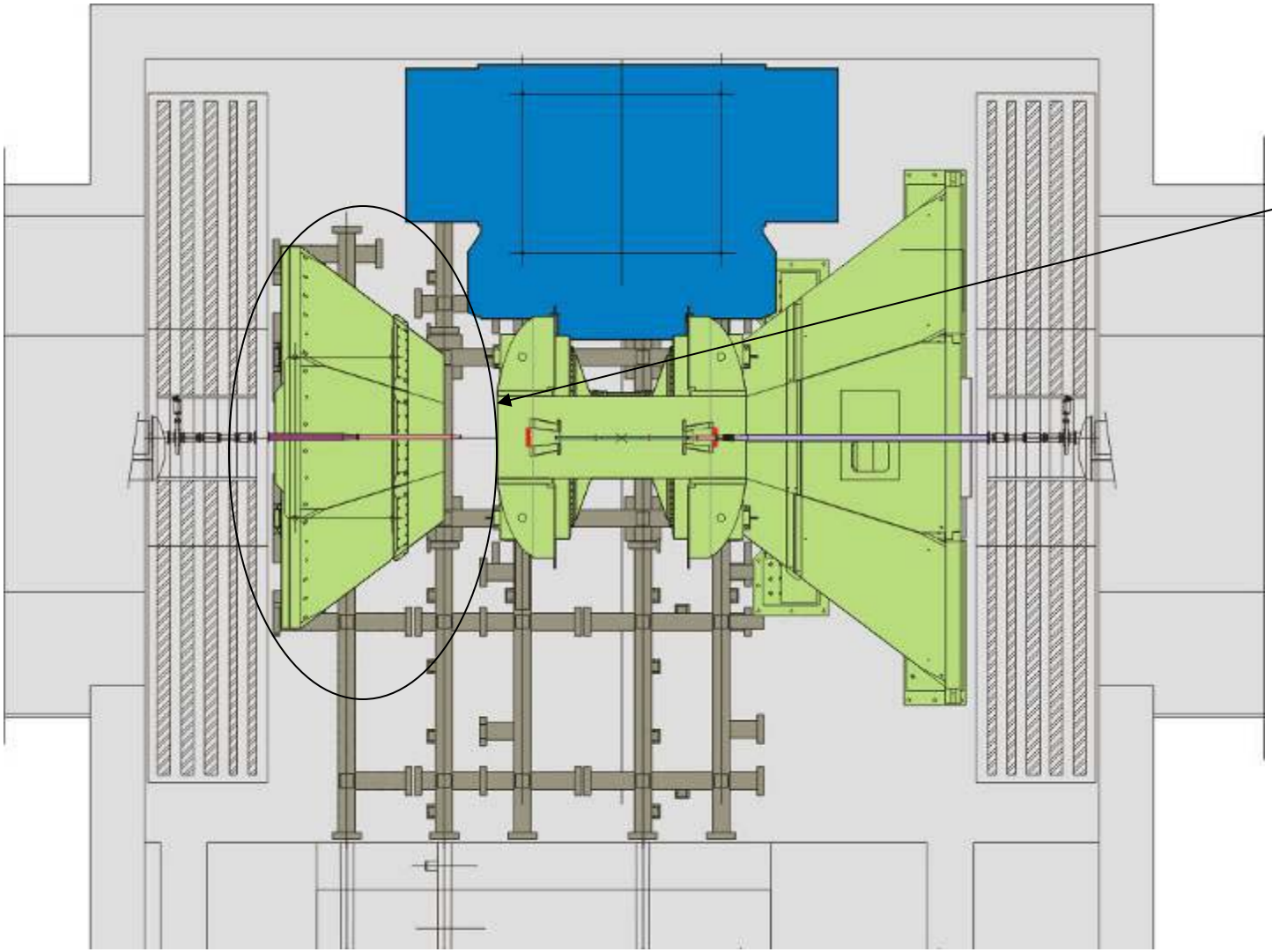


Step 20:

Move MMS into IR east area. Slide 1 5/8 to 3 " transition, Bellows & 3 to 5" section into MMS. 3-5" transition should be fitted with rolling support, bakeout heaters, bakeout blanket and bakeout instrumentation. Field fashion temporary support for these BP sections in MPC cavity and south end of MMS.

Note: The assembly of 3 BP components that are connected prior to installation Must be leak checked by CAD vacuum techs prior to installation in the MMS

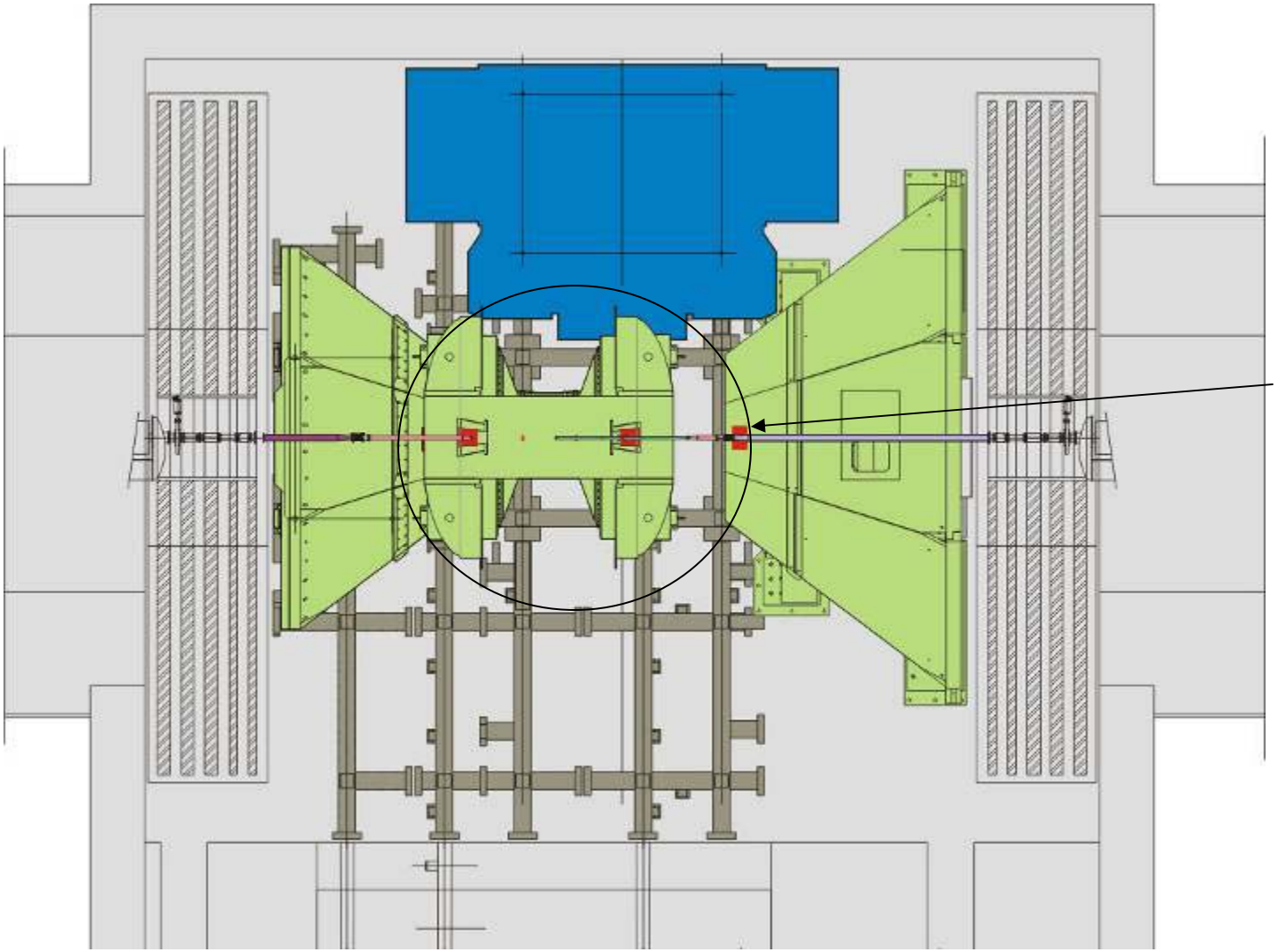
New Beampipe Installation Plan



Step 21:

Move MMS to beamline axis then retract to south position.

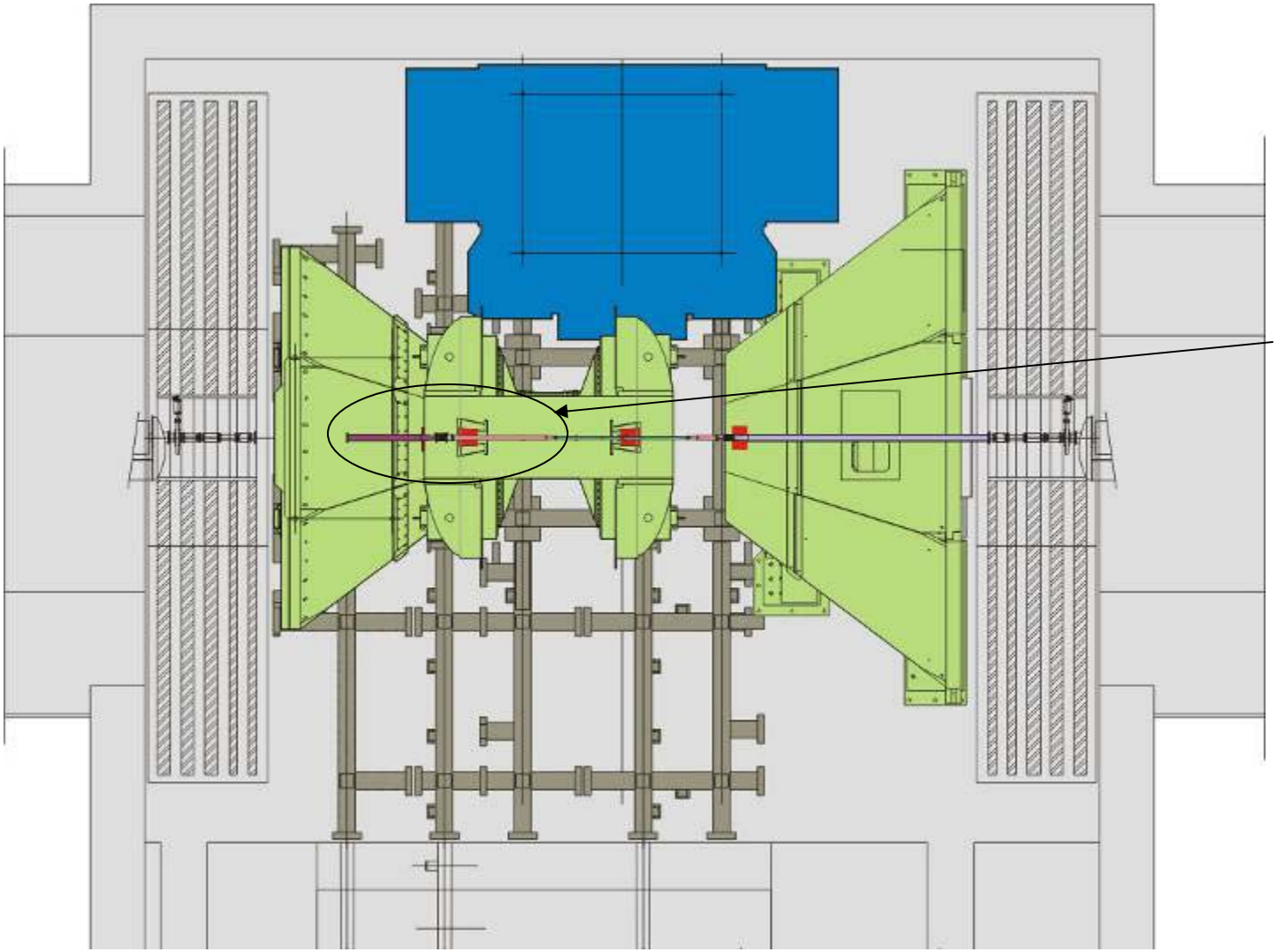
New Beampipe Installation Plan



Step 22:

Move CM south. Take care to support the Be/Alum BP in the CM region during the CM move.

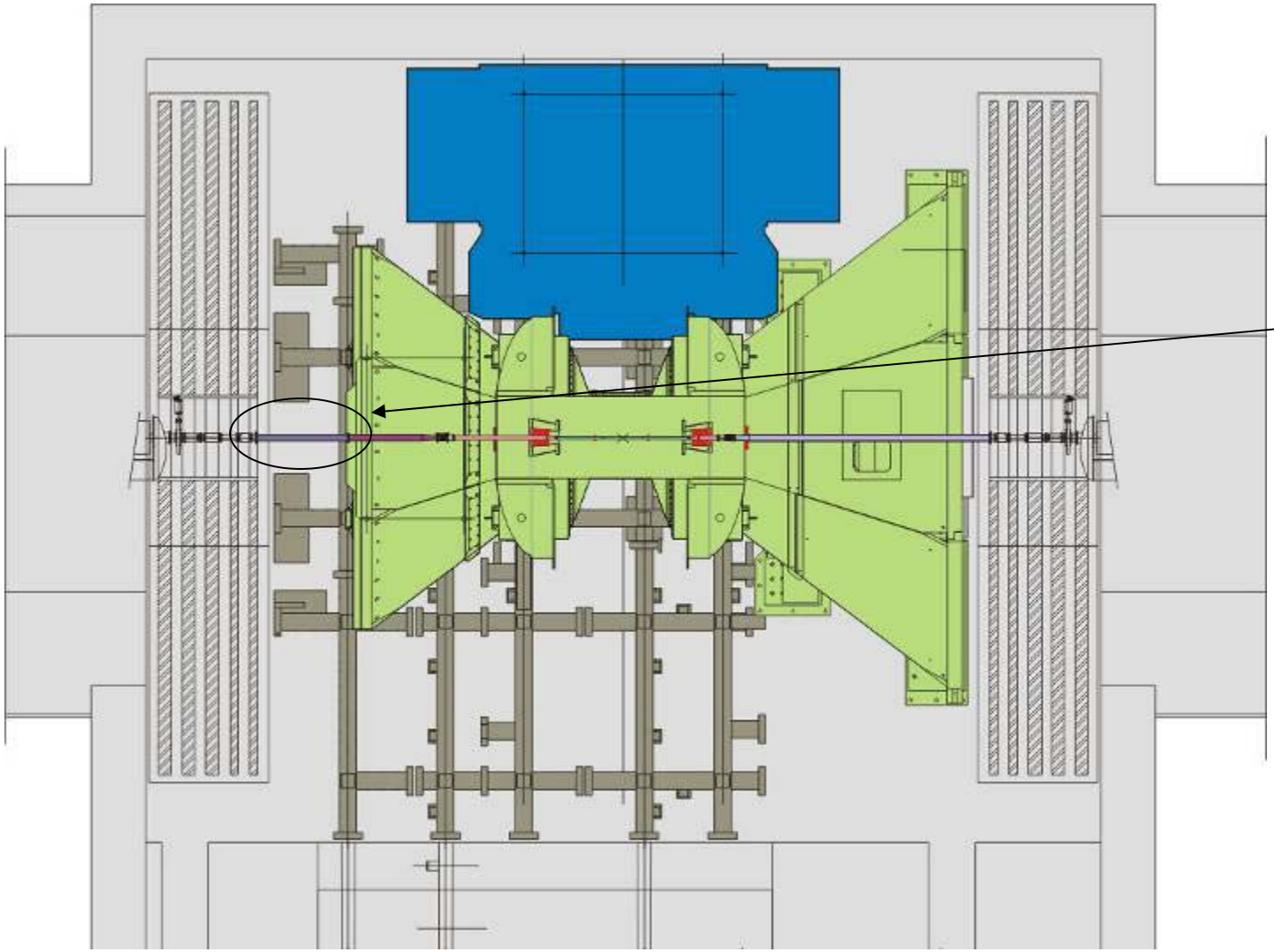
New Beampipe Installation Plan



Step 23:

Slide MMS Beam Pipe sections past Cu Nose cones and attach to new Be section

New Beampipe Installation Plan



Step 24:

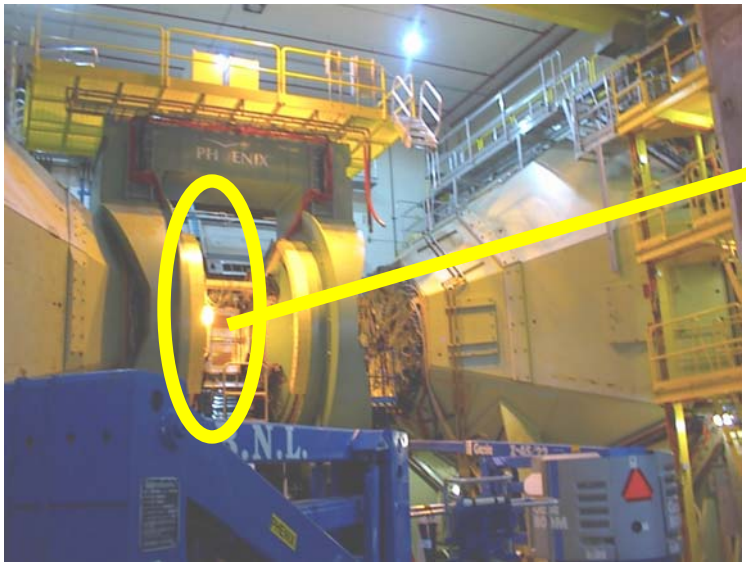
Move MMS and CM into Run position – Attach last section behind MMS

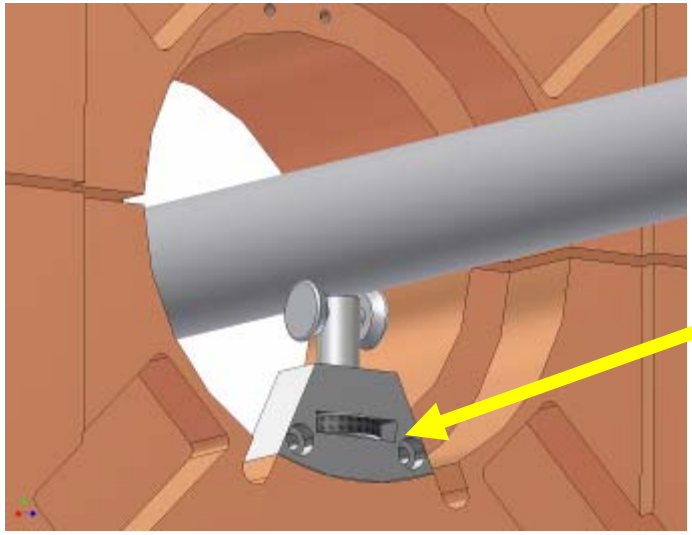
New Beampipe Installation Plan

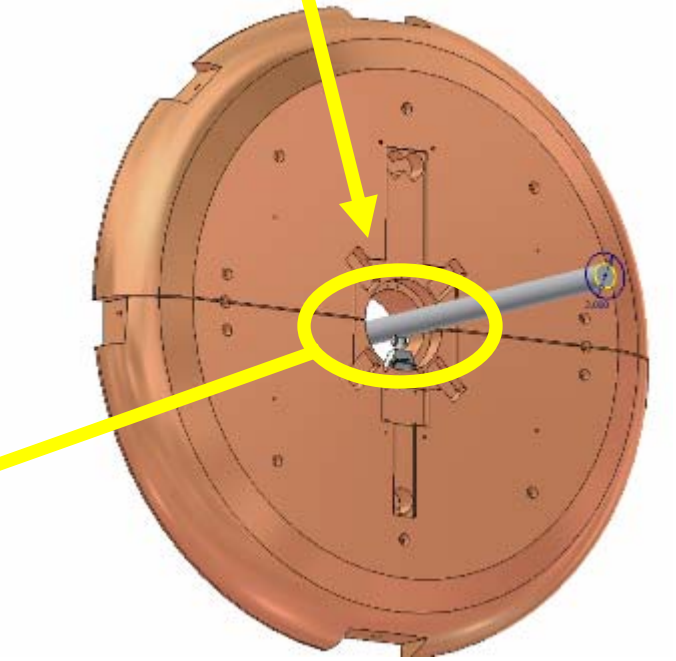
Beampipe Alignment

New Beampipe Installation Plan

CM central BP supports (2)

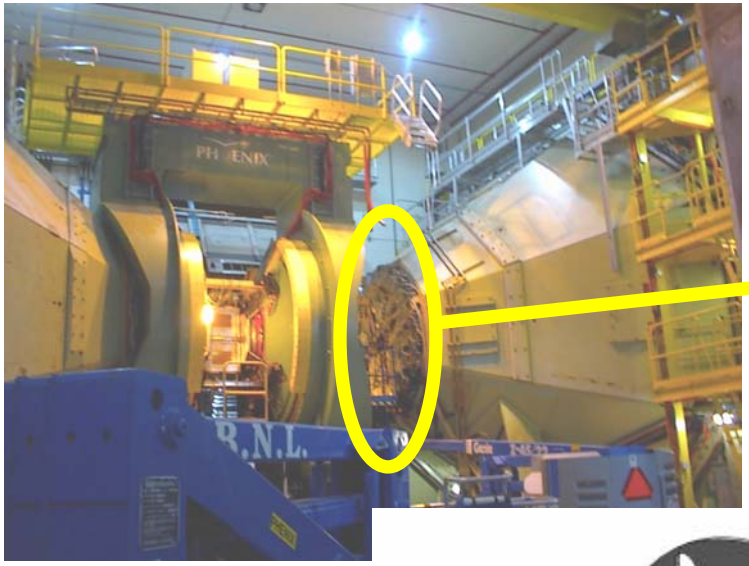


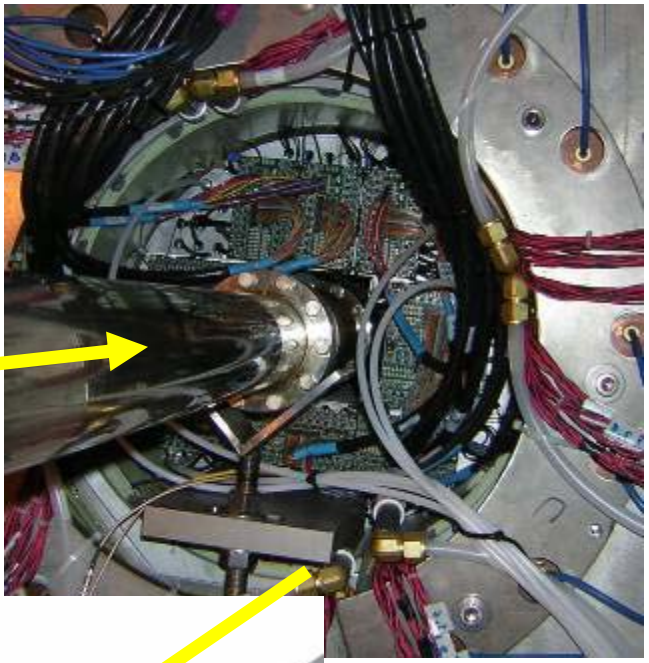


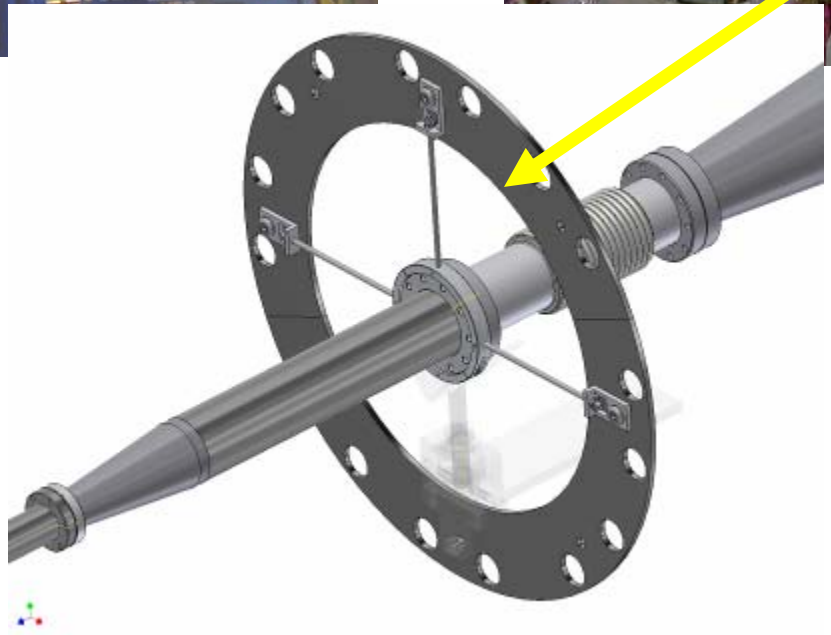


New Beampipe Installation Plan

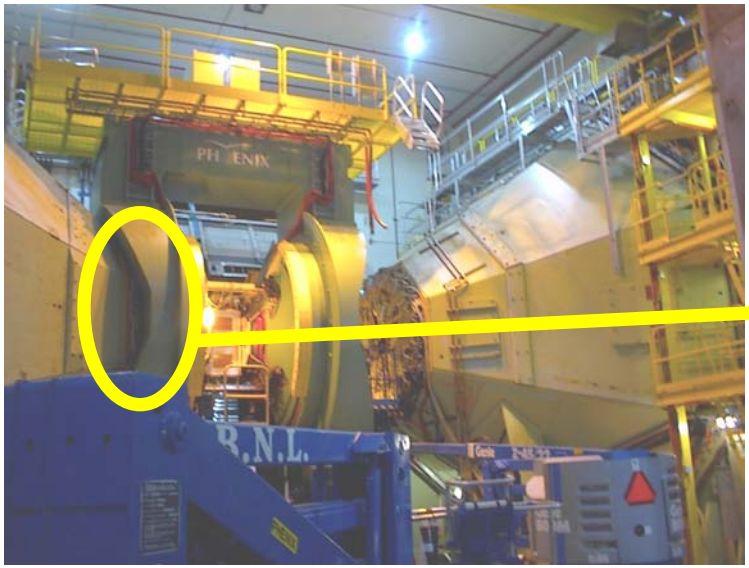
North MPC/MuTr Station 1 support



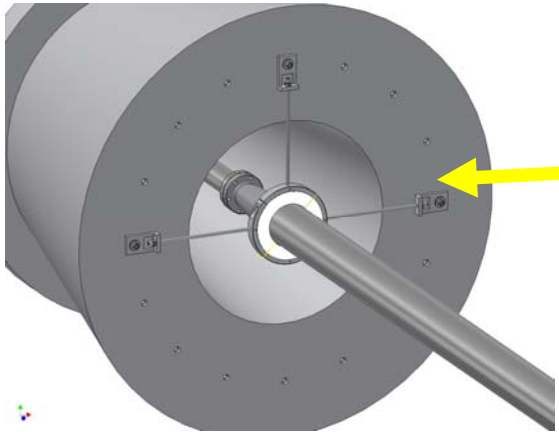


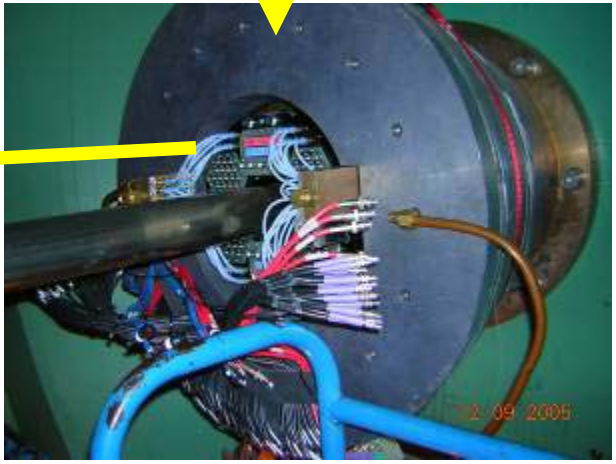


New Beampipe Installati



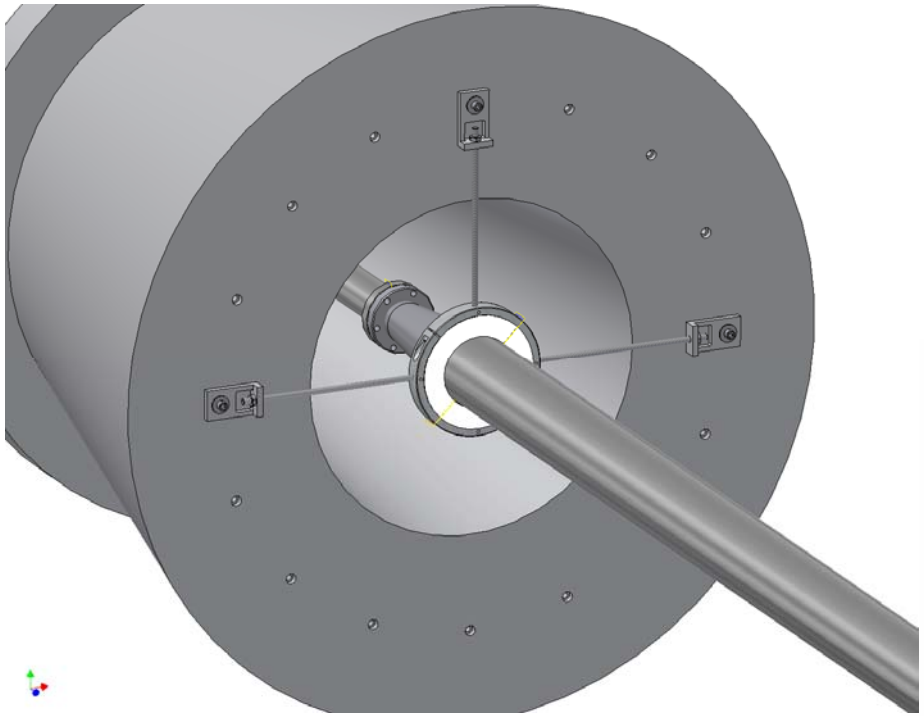
South Flowerpot BP support





New Beampipe Installation Plan

South BBC Cavity BP support

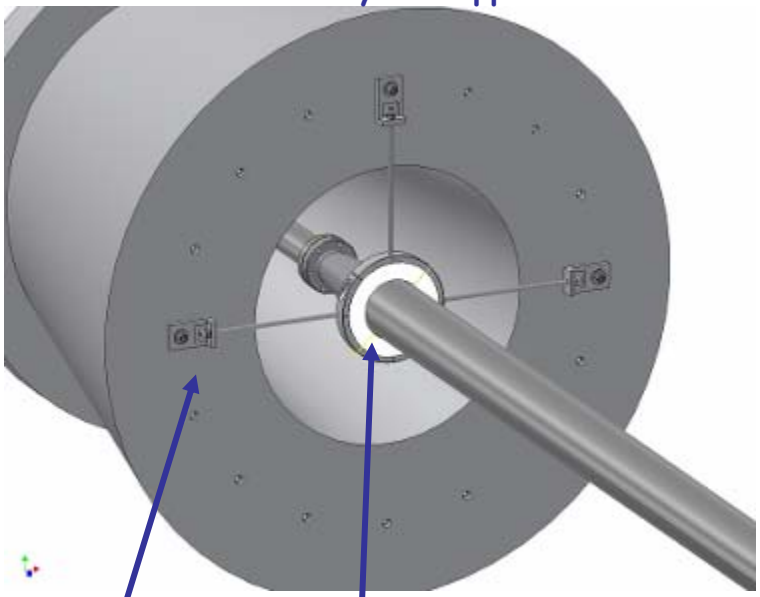


All alignment adjustmants for the central beampipe section are made using these 2 beampipe supports

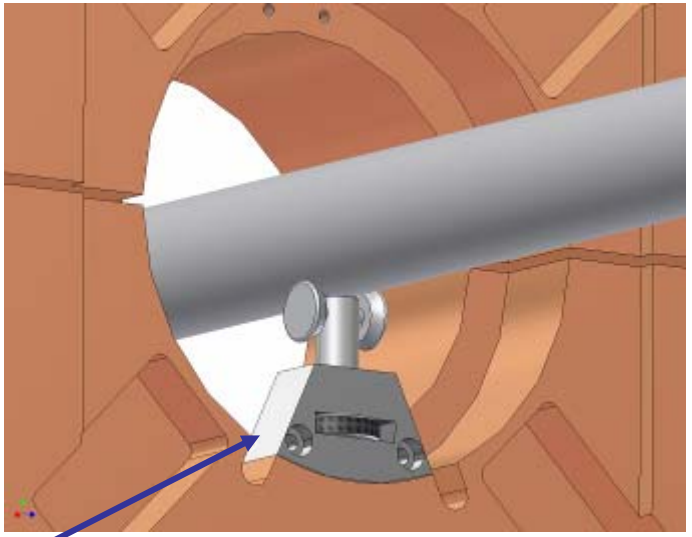
North MPC Cavity BP support

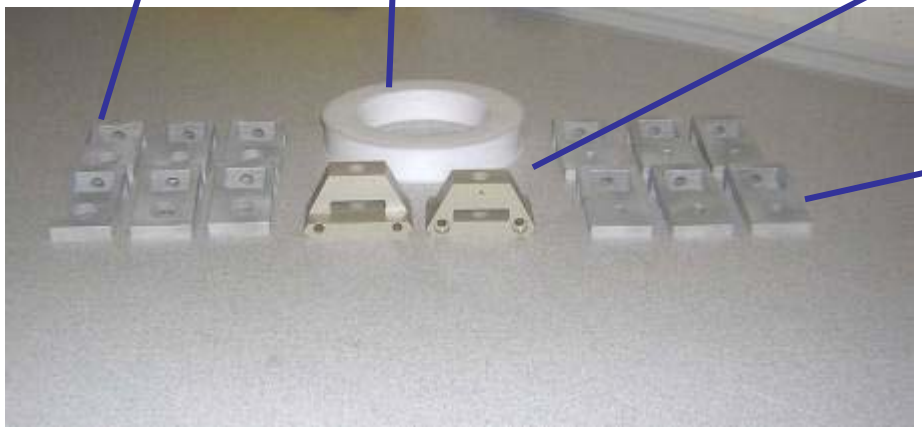
New Beampipe Installation Plan

South BBC Cavity BP support

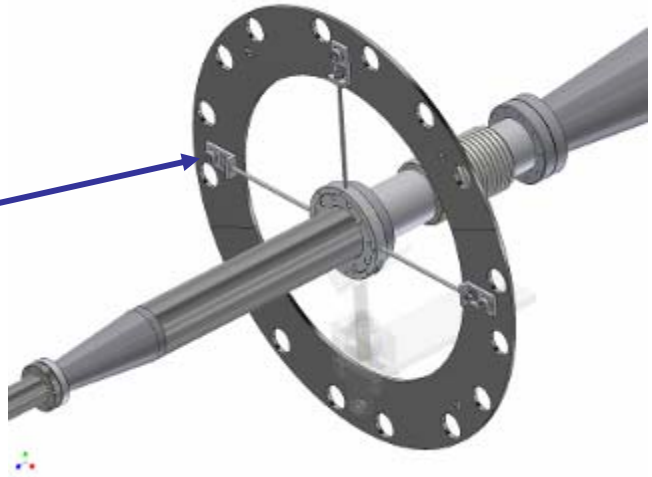


CM central BP supports (2 req'd)



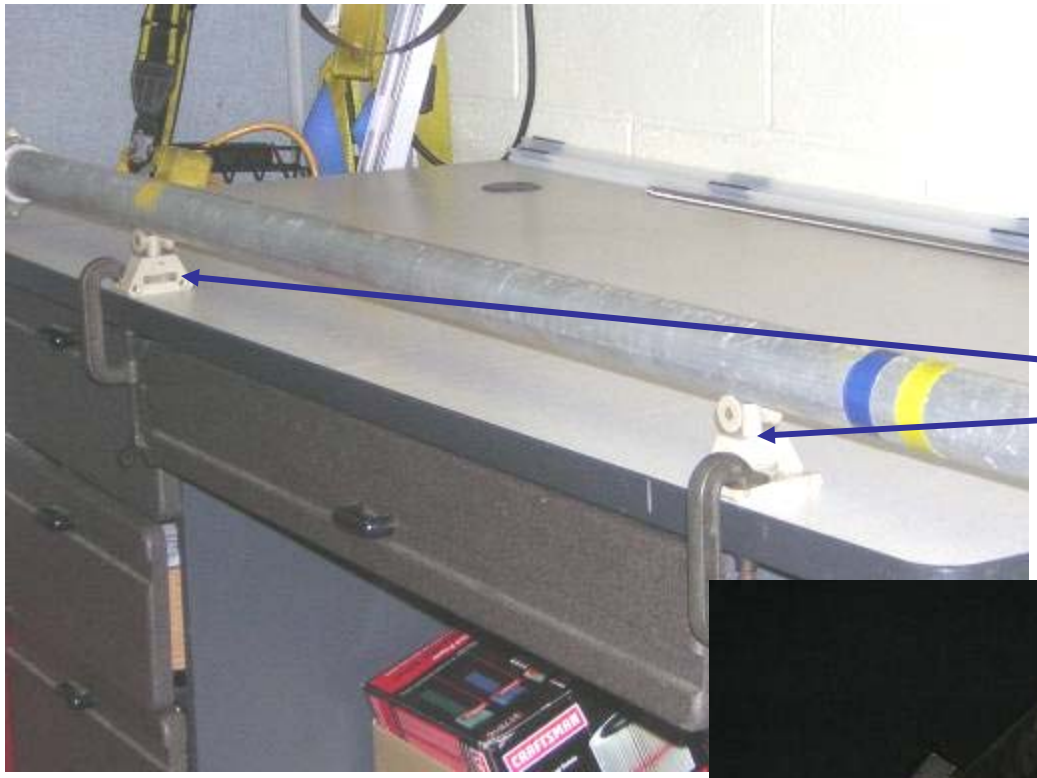


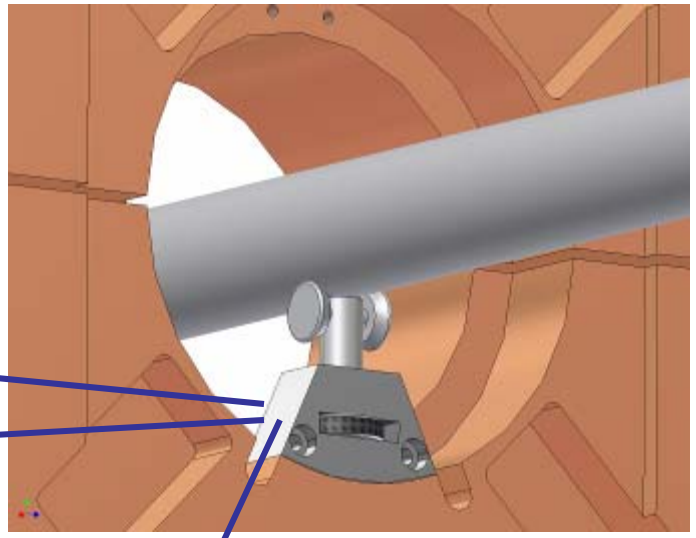
BP support components from CS



North MPC Cavity BP support

New Beampipe Installation Plan

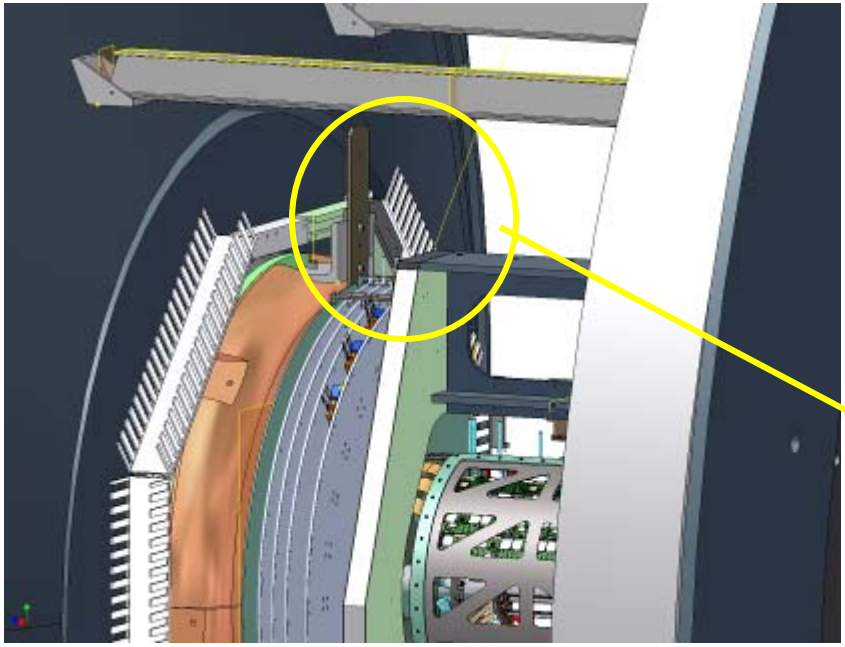


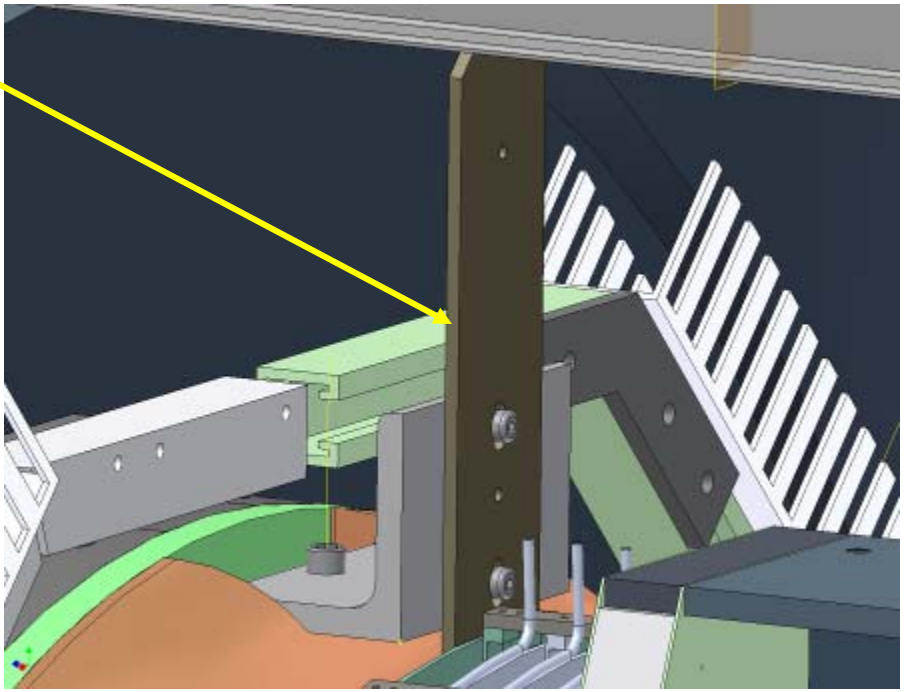


Central beampipe
section rolling supports

New Beampipe Installation Plan

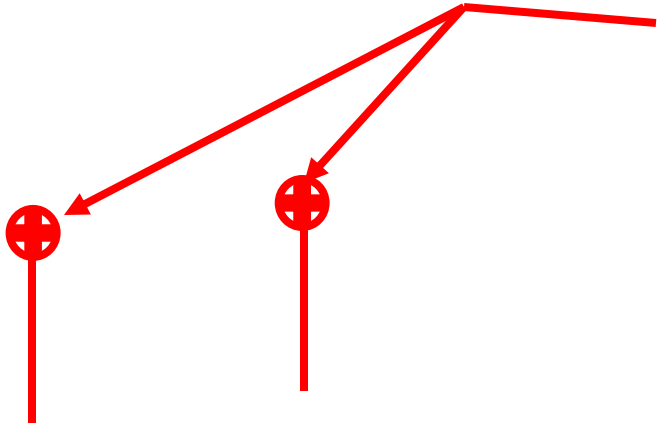
Beampipe Survey





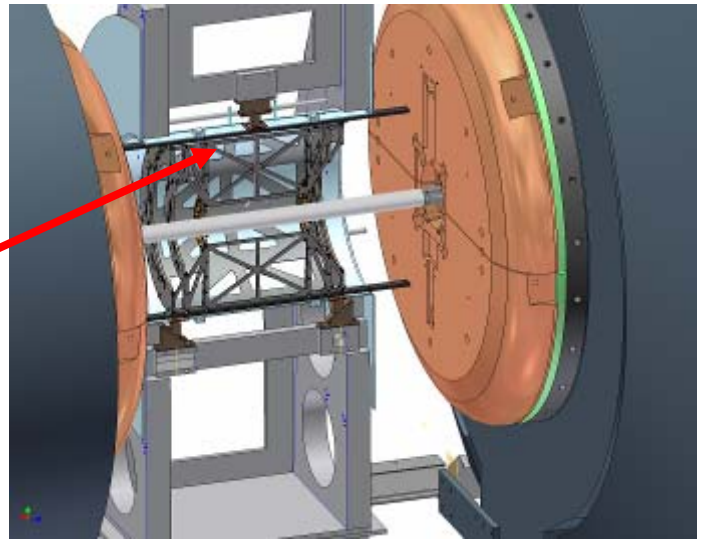
2 survey tools are positioned at either end of the VTX and attached to the nosecones. Each tool holds 2 targets and has a v groove to contact the central beampipe.

New Beampipe Installation Plan



Survey Targets and fixtures TBD
Must be able to align BP to req'd radial and angular accuracy without VTX and with VTX in clamshells open configuration.

½ of VTX detector support structure



New Beampipe Installation Plan

Vacuum Preparation and Testing

After the new beampipe, spool, transitions and bellows are all in place connected and pumped down to vacuum, the new sections shall be baked to 200°C for a period to be determined by the CAD vacuum group.

After bakeout the entire new beampipe assembly shall be leak tested.

After leak test, re-install the north and south BBC and MPC detectors.

New Beampipe Installation Plan

Final survey

After all detectors have been re-installed a final BP survey shall be performed.

Installation of the new VTX detector may now begin.